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VOLUME, 109, NUMBER 25

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Construction and Detroit—An Editorial..... 737

Is Municipal Credit Sound?..... 738
By CARL C. CHATTERS

Efficient Pile-Casting Yard for Highway Bridges..... 743

Extensive Use of Light Railways in China..... 745

Friction Piles in Muck Sink Evenly Under Load..... 746

Cleveland Again Bridges Cuyahoga Valley..... 747

Reinforced Brick Masonry on Dearborn Sewer System..... 749
By CHARLES H. FORK

Coordination of Water Rates and Construction Programs.... 750

Building a Low-Cost Base for a Low-Cost Road..... 751
By JOHN S. CRANDELL

Imhoff Tank Effluent Aerated to Reduce Filter Load..... 752
By W. R. DRURY

Letters.....753 Book Reviews.....756 Editorials.....758
News.....760 Equipment.....765 Unit Prices.....766

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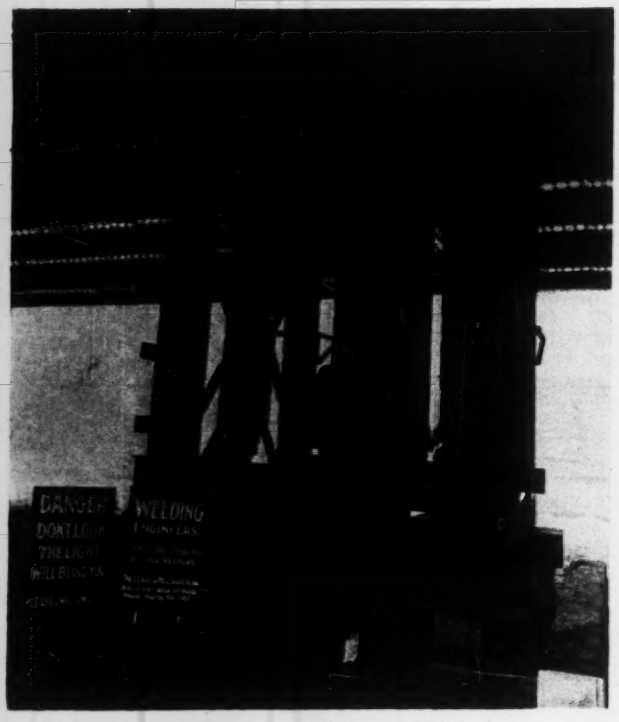

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Vol. 109 New York, December 22, 1932 No. 25

Is Municipal Credit Sound?	738	Aerating Imhoff Tank Effluent	752
Casting Yard for Bridge Piles	743	Letters to the Editor	753
Light Railways for China	745	Book Reviews	756
Friction Piles in Muck	746	Editorials	758
Lorain-Carnegie Bridge, Cleveland	747	News of the Week	760
Reinforced Brickwork for Sewers	749	Equipment	765
Water Rates and Improvements	750	Unit Prices	766
Low-Cost Base for Low-Cost Roads	751		

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Construction and Detroit

A SCORE of construction groups and industries will meet next month in a highway and building congress at Detroit. For the first time the leading elements of construction are to assemble within earshot of each other, animated by a recognition of their common interest. They will fail in their duty if they depart from this meeting without having taken united action to re-invigorate the spirit of the construction industry and make it a strong influence in the world which it serves. Detroit offers them an opportunity to build their industry into an organized working unit of our economic structure.

CONSTRUCTION is under attack from every side. Business, industry, finance, the public, look askance at it as unnecessary and wasteful. Its resources are being raided everywhere and are being diverted for distribution as doles. Men are thrown out of employment only to go on the community's relief lists. The effect on business, on individual morale and on the wealth and prosperity of the community is disregarded in the process. Meanwhile, the industry stands inactive and unready, lacking unity of purpose and means and the knowledge with which to strike back effectively.

ITS WEAKNESS lies in lack of unity. The separate groups of construction have never interested themselves in matters of construction as an industry. Centered on their own affairs and internal troubles, they have given little heed to their interrelation and their mutual misadjustments. They have been both unwilling and unable to measure their market or to appraise their influence upon the cost and efficiency of the industry's final product. They have been unconscious of their obligation to the community as well as to the construction industry itself. And so the industry which exists by virtue of the need for its product, the value and low cost of what it builds, is not equipped either to control or to defend its performance, and lacks the essential information through which to sell its service to the community.

MOREOVER, in addition to its economic function, construction has social obligations. If it is to keep step with the times, it is bound to adjust its operations not only for efficiency and economy but with a view to stability of employment, seasonal continuity and adequate compensation for its workers, so that they may rank with other citizens and contribute their part to the vital circulation of purchasing power through wages, production and distribution. With respect to this obligation also, the industry is powerless to make progress so long as it is disorganized. It needs unity on every count.

NUMEROUS groups cooperate in the service of construction. They include the administrators of business, public officials, the professions of architecture and engineering, contractors, producers of materials and tools. Today this aggregate of interdependent interests is split up into units that hardly know each other and that have made only faint-hearted efforts at cooperation. Yet, since the joint action of all these groups is necessary to full performance of the industry's service, the groups need to be geared together effectively for harmonious action if they are to progress.

MANY of these groups are included in the list of organizations that will meet at Detroit. If all of them bring to that meeting a strong consciousness of construction's vital need for unity, and if they organize the industry to make that unity effective, they will regain their faith in the great mission of construction and acquire courage and power to battle against the hostile forces that now threaten the industry's stability, and indeed its very existence. —THE EDITORS.

Is Municipal Credit Sound?

An Examination of the Facts

Municipal bonds show a splendid record of repayment—Short-term borrowing is a widespread evil, resulting from poorly adjusted tax-collection calendars—Taxing systems as well as budgeting and accounting need improvement

By Carl H. Chatters

Executive Director, Municipal Finance Officers' Association, Chicago, Ill.

● We have been told over and over in the public press that municipal finances are in a deplorable condition. The popular belief is that cities in increasing number have defaulted on their obligations and that many others are in imminent danger of doing so. Is this popular view correct? Certainly, it seems to be supported by the distressing experiences of some of the larger municipalities in their attempts to borrow money to cover current expenses.

● But in the following article Mr. Chatters asserts that municipal finances are essentially sound and he presents a great amount of supporting evidence. Bond defaults, he states, have been insignificant in number and amount and in the majority of instances they are attributable to boom-time overdevelopment of subdivision real estate. Long-term debts have been steadily increasing but now are contracted for more legitimate purposes than was so in years gone by.

● Many improvements in financial practice are greatly to be desired, and the author clearly indicates what they are. They lie largely in the fields of tax collection, budgeting, accounting and advance planning. Their adoption would go far toward dissipating the unwarranted doubts about municipal finance and providing a much-needed market for municipal securities in times of economic stress. —EDITOR.

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IS IT TRUE that most large cities are bankrupt? Are there evidences of widespread inability of municipal governments to discharge their obligations? A widespread impression exists that the great majority of our municipal corporations are either insolvent or about to become so.

In this article evidence will be presented to show that municipal credit is essentially sound. It is true that many improvements are desirable in fiscal policies and procedures, and specific recommendations will be made for bringing them about, yet, in general, municipal securities unquestionably rank in safety and dependability second only to the obligations of the federal government.

Ask the first man you meet what he knows about the finances of the city of Chicago, and he will tell you that it is in default on its bonds. As a matter of fact, the city of Chicago has promptly paid all of its bonds and interest as they came due and has a relatively light debt burden. It has been having difficulties with its current financing brought about largely by inadequate assessment machinery. But any unfavorable event in a municipal government receives great publicity, whereas a forward movement goes almost unnoticed. There was no news interest in the fact that practically every local government met its bond and interest payments promptly for many years prior to the present depression. Municipal credit became news only when trouble developed. Of course, all the misconceptions did not come from printed pages. Those whose pocket nerve was touched by a municipal default were not slow in telling the world about it. But let us examine the record in the case instead of relying on gossip to form our opinion on a subject of such vital importance.

Let us look at the recent report of the Municipal Securities Committee of the Investment Bankers' Association of America. This relates the number of bond defaults in counties, cities, villages and school districts of the United States having a population in excess of 1,000. Municipal bond defaults existing on Oct. 15, 1932, were as follows: eleven states, no defaults; seventeen states, one to five defaults each; five states, six to ten defaults each; fifteen states, more than ten defaults each; state governments, no defaults. This excellent record certainly does not bear out the popular thought that no city is paying its debts.

Closer reading of the daily news accounts will reveal that most of the present fanfare of publicity is over the difficulties that cities are having in raising money on short-term notes to meet current expenses. It might well be asked: How does the necessity for such borrowing come about, and what are its consequences?

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Borrowing for Current Needs

THE CITY of New York borrowed $265,000,000 on tax-anticipation notes in 1931, according to the annual report of Charles W. Berry, comptroller. This is indicative of the situation in many communities and is brought about by a poor adjustment between the tax-collecting and tax-spending periods. It is surprising to know that only twelve of the 25 largest cities in the United States properly harmonize these periods, and that only one-third of the cities with a population of 100,000 to 300,000 collect their taxes at or near the beginning of the fiscal year. Even some state governments find it necessary to borrow for long periods in anticipation of tax collections.

The extent of tax-anticipation borrowing for the first ten months of 1932 is disclosed by figures taken from the weekly *Bond Buyer*. Reported sales of short-term paper aggregate $936,640,000. This figure includes only the larger loans and does not account for the borrowing of thousands of smaller governmental units. Long-term municipal loans during the same period were $695,000,000, or 25 per cent less than the total of temporary loans. The New England group of the Investment Bankers' Association of America in a recent report states that the total volume of such borrowings amounted to $153,000,000 in 1931 for the towns and cities of Massachusetts alone. The $265,000,000 that New York borrowed in 1931 carried interest at rates varying from 1½ to 5½ per cent per annum, and the loans were made for periods extending from 61 to 365 days. Obviously, the interest cost is considerable. Not many years ago the special joint committee on taxation and retrenchment of the New York State Legislature discussed short-term borrowing as follows: "In Utica for two-thirds of the year the city is forced to operate on funds borrowed at 4 to 5 per cent interest. The cost of this system for Utica in 1919 alone is placed at $20,000. In Syracuse the cost is $50,000. In New York City the comptroller has stated that the cost is approximately $3,000,000 annually."

The city of Chicago, even in normal times, was compelled annually to borrow on tax-anticipation notes for many months. In some cities—for example, those in Massachusetts, New Jersey, and Oklahoma—state laws make the practice unavoidable.

Those who seek to reduce the cost of government should first try to eliminate the expense of this unnecessary borrow-

ing. No employee would be put out of work, and no manufacturer would be deprived of sales by such action. A conservative estimate of the possible savings in the United States from this source is at least $40,000,000 per year.

The inability and refusal of banks to make short-time loans during the past few months have led to many of the defaults of municipal bonds, to the passing of payrolls and to the curtailment of essential activities, including schools, fire departments and police departments. Many cities in need of short-term credit have become subject to the dictation of banking groups. Even the large cities of New York, Chicago and Detroit have had to recognize the bankers' demands. Their requests may have been entirely reasonable and just, but the condition indicates a definite trend in government to have policies and detailed operations of government thus supervised.

The primary cause of tax-anticipation borrowing is well known. It lies in a poor adjustment of fiscal periods, as stated above. The remedy ought to be simple. However, many observers think that the same banking interests that oppose excessive municipal expenditures have taken an active part in defeating legislative acts that would tend to do away with the borrowing.

Ohio gives an excellent example of a proper tax-collecting system that eliminates the need of tax-anticipation borrowing. The fiscal periods of all local governments in that state begin on Jan. 1. There are in Ohio only as many tax collectors as there are counties, and taxes are collected in two equal semi-annual installments, the first payable Dec. 20 and the second on June 20 following. As a result, Ohio cities in 1931 paid only $90,554 interest on general floating debt, and none of this was paid by the five largest cities. This is a striking contrast to the practice in New York.

Better tax-collection procedure everywhere is needed to reduce loans. The laws relative to the collection of real estate taxes must be strengthened, and the administration of these laws must be prompt and impartial. Furthermore, some initiative must be exercised by collecting officers in the use of extra-legal means in obtaining payment. Careful studies of tax-collection methods have revealed that the principal weakness lies in the lax administration of the existing statutes. This can be corrected in part by more capable personnel. Further, taxes might be made payable by installments to suit the needs of the taxpayers. Where it is impossible to adjust the fiscal periods collections should be made in advance through the sale of prepayment certificates, as in Toronto, Ont., or by collecting tax installments in advance of the due date, comparable to the practice recently inaugurated in Detroit, Mich., and Portsmouth, Va.

City officials used to feel that they could spend an amount equal to their tax levy plus any miscellaneous revenues from fines, fees and permits. In most communities this was a safe procedure because collection ratios were constant. The delinquent taxes of previous years were collected in sufficient volume to offset unpaid items of the current year. But as tax delinquency increased, how many city councils took heed? Very few. They assumed that the difference could be borrowed. Even that was true for a while. Now bankers will not loan money with delinquent taxes as security. They know that tax sales are not being held as the law requires; and even if they do take place, no one appears to buy the tax liens or tax certificates. They know, too, that many parcels of land are so burdened with taxes that no one wants them. Two things are necessary for a city to correlate its tax collections and its budget. First, it should plan to spend each year only what can reasonably be expected to come from collections. Second, it should collect taxes with all the vigor the law allows and devise some means for re-establishing on the tax rolls lands which the city itself must acquire because of tax liens.

A study of the short-term debts of any city and of the causes that make them necessary probably provides the best single index to a city's immediate financial future. Large loans in themselves do not indicate trouble, but borrowing that has been caused by poor tax collections or excessive spending certainly shows that a municipality has difficulty ahead. On the other hand, the ability to operate and meet current obligations at all times without short-term loans indicates that a city has been handling its finances well and that it will not become subject to default by placing itself at the mercy of its creditors. The principal remedies for short-term borrowing, then, are the adjustment of the tax-collecting period to the spending period, the collection of taxes by installments either in advance of or during the collecting period, and a budgeting system that will control expenditures within the city's actual income.

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Financing Capital Expenditures

DEBTS of local governments are now of such magnitude that incompetent fiscal administration cannot be afforded. Comparisons with the figures of past years are given here to impress upon the reader their expanding volume.

LOCAL GOVERNMENT DEBTS IN THE UNITED STATES*

1842	27,400,000
1870	328,250,000
1880	698,270,000
1922	6,316,600,000
1929	11,874,800,000

*The figures for 1842, 1870 and 1880 are taken from H. C. Adams' "Public Debts," published in 1887; and those for 1922 and 1929 from "The Cost of Government in the United States, 1929-30," published by the National Industrial Conference Board.

But it must be appreciated that the debts of cities are now being created for improvements from which the citizens can expect some definite benefit or use. This is in contrast to the situation in 1880, when approximately 40 per cent of the total state and local debts outstanding consisted of bonds issued for the funding of floating debts, the refunding of old debts and bonds sold to build or assist railroads. Today the debts for such purposes do not amount to more than 10 per cent of the total. Such a change is significant because taxpayers are not likely to resent or to repudiate debts created for purposes directly benefiting them, whereas they are often antagonized by burdens which they find were imposed for no constructive purpose.

The most significant and hopeful change in debt administration has been the marked trend from the use of sinking-fund or term bonds to the use of serial bonds. Sixteen states in 1930 permitted only serial issues. Such a change brings about an earlier payment of the debt and a lesser amount of gross debt outstanding. A city which must begin to pay its bonds the year after they are issued will not be as likely to bond excessively as one which can defer payment for an indefinite period. Another advantage is that sinking funds are eliminated through the use of serial bonds, thus avoiding mismanagement of municipal debt reserves.

The term for which muncipal bonds are issued should in no case exceed the estimated life of the improvement to be constructed. This is axiomatic and has been quite generally observed. Six states very definitely limit the terms of bonds issued by their cities. However, four of them are among the states with the most municipal bond defaults. This sample shows that no one criterion can be used to judge the quality of municipal bonds.

At one time the issuance of bond-anticipation notes appeared to be a device that could be used by cities to save interest costs and excessive bonding. Under this plan a city would issue short-term notes to finance improvements during construction and at the completion of the work would sell long-term bonds to take up the notes. This policy presupposed that a market would always exist for municipal bonds. Many such bond-anticipation notes were outstanding in Ohio in the fall of 1931 when England went off the gold standard. Immediately following this event, there

was practically no market for municipal securities, and the notes went into default, compelling the holders to accept long-term bonds for their short-term notes or the cities to be considered in default on their obligations. Undoubtedly the bond-anticipation notes should be used, but only when it appears certain that the long term bonds to replace them can be disposed of when required.

The pay-as-you-go plan for building public improvements is gaining in favor. It permits the construction of improvements without adding to the original cost the charge for interest, which in many cases doubles the cost of a municipal project. The use of both the pay-as-you-go plan and the retirement of bonds by the serial method permits the expenditure of far greater sums for construction over a period of years without increasing the bonded debt at any given time. In short, this policy provides for a more rapid turnover of the capital expended for public improvements.

The long-term debt situation may be summarized by saying that policies are becoming more favorable for sound investment in municipal securities. This is brought about by new tax limitations, by the issuance of serial bonds, by controlling the term of years for which bonds may be issued and by the adoption of the pay-as-you-go plan.

The local revenue system

It is obvious that debts of any nature can be discharged finally only through the city's income. Cities have been relying almost entirely upon the real estate tax for their revenues. In 1930 the cities of more than 30,000 population in the United States obtained 70.7 per cent of their revenue from general *ad valorem* and special-assessment levies against real estate. But, unfortunately, the valuation of real estate for purposes of local taxation has been confused with tax rates and governmental costs until citizens think that a lower valuation means less taxes. No such miracle results. The assessed valuation of property is only a relative matter. Its primary purpose is to form the basis for distributing the tax burden among the various property owners. Whether assessments are high or low is immaterial, except where taxation has reached its maximum lawful rate. If all valuations in any city were doubled, such an act, *per se*, would have no effect on the taxes of any individual. The rate would be halved but would then be multiplied by a valuation twice as large as formerly.

There is a cry that valuations should be reduced because of shrinking values. This simply means that all valuations should be reviewed periodically to see that they are mutually equitable. Certainly the prices established by forced sales during a depression cannot be used as a basis of equalizing assessments. Only scientific assessment procedure, involving the use of land-value maps, the classification of buildings by types and a uniform cubic-content value for buildings of similar type, will insure a fair and equitable distribution of the tax burden.

It seems to most observers, however, that the reliance largely upon real estate taxes must be modified and that other sources of revenue must be located for the local governments. An increasing number of states is now sharing the gasoline tax with the cities. Wisconsin and Massachusetts distribute the income tax locally, the latter returning to the local governments the total tax, less the expense of collection. New York returns more than $100,000,000 per year to the local governments as grants in aid. Some state authorities think that the cities ought to find locally new sources of revenue, in spite of the fact that the states themselves have been withdrawing from local taxation many desirable sources of income.

It is not to be supposed that a local government can adopt or administer a revenue system of its own. Locally administered sales taxes, income taxes, and business taxes would be only a farce. For satisfactory results there must be developed an integrated revenue system in which each jurisdiction collects the tax it can administer most economically, with the revenue so derived distributed equitably to other units of government. There is also a need to distribute properly the burden of taxation over all classes of wealth.

DIRECT ANSWERS to these vexing questions are given by Mr. Chatters in the accompanying article:

Why must a city borrow money to meet its payrolls and pay its bills?

To what extent are municipalities indebted to their citizens?

Wherein are cities at fault in their fiscal policies?

How efficient are budgeting and accounting?

Are tax-collection methods all that they should be?

What does a lower level of property assessments signify?

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Budgeting and Accounting

"IT MAY BE SAID that the accounting system is an extraordinary mixture of the modern and the antiquated, without the virtues of either." These words summarize Prof. Thomas H. Reed's recently expressed opinion of the financial structure of one of the larger counties of the United States. If this indictment could be confined to the county referred to, it might be passed up lightly. Unfortunately it is typical of the condition existing in a great number of American counties, townships, cities, villages and school districts.

There can be no permanent improvement in the financial affairs of cities until budgeting, accounting and reporting have been raised to a higher level. Indeed, the quality of municipal accounting in the past has been one of the contributing factors to the present financial difficulties. The failure of public officials to render an intelligible report of their activities and expenditures to the citizens has contributed in no small degree to the suspicion and disrespect with which they look upon their governments. In one of the more populous states a survey of the accounting and budgetary practice was made by a competent observer. He states that only twelve of the 54 cities in the state have budgets that are worthy of the name. Another observer visited about 80 cities last year and reported that only 10 per cent of them had accounting systems that could be called at all satisfactory. On such a foundation as this it is impossible to build a financial structure that will guide administrators and citizens along a proper financial path. It should be noted too that the United States is one of the few progressive nations where complete and accurate data about local governments are not currently compiled.

There has been material progress, however, in the field of municipal accounting since the beginning of the twentieth century. The very fact that the present depression reveals the weaknesses of municipal accounting is a hopeful sign, for the disclosures will encourage reform.

But citizens and officials alike ought to know more about the "balanced budget," which so many of them worship, and should understand clearly what it implies. There seems to be much confusion on this subject. For example, the popular conception of a balanced national budget is inconsistent with the common definition of a balanced local-government budget. The federal government, to balance its budget according to terminology used in the past, is expected to raise sufficient revenue in any one year not only to pay the ordinary expense of government but to build all of its public buildings, meet the interest on government loans, retire the public debt, furnish the capital for new enterprises such as the Reconstruction Finance Corporation, and take care of expenditures of an emergency character. Economists contend that the federal budget more properly should be considered balanced when it has pro-

vided for the ordinary expenditures, and that in times of a depression it would be economically sound and a contributing factor to recovery to leave the federal budget unbalanced in the present sense of the word and to finance all the extraordinary expenditures, and even part of the regular operating expenditures, by an increase of the public debt.

The budget of a city, on the other hand, is considered balanced if the revenues in any one year are sufficient to meet the operating expenses, interest costs, debt retirement and whatever part of the outlays is budgeted from current tax funds. When city finances are viewed in this light the Census Bureau's report reveals that only seven cities out of the 309 having a population in excess of 30,000 failed in 1930 to receive revenues in excess of their payments for operation, maintenance and interest. Furthermore, 106 of the cities realized enough from revenues to meet all their payments for operation, maintenance, interest and outlays, and to have a balance available for paying debt. Certainly this is adequate support for the contention that cities are not spending beyond their means to the extent that has been popularly advertised.

Few think it a fallacy to borrow to finance local improvements, but strangely enough there is almost universal condemnation of the national government if it fails to obtain from current revenues enough to meet all disbursements regardless of their nature. Both federal and local governments in periods of deflation should be permitted to borrow for the purpose of capital expenditures.

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The Problem of Bond Defaults

MUNICIPAL bond defaults today are not alarmingly extensive when judged by the percentage of defaulted obligations to the total outstanding, when the geographical distribution is noted, or when compared to the defaults on private debt obligations. The bonds of no state governments are in default. In eleven states no municipality is in default. Only one New England city has been in difficulty. Twenty-eight states have five or less municipal defaults each, and altogether account for only 36 defaults. In the other twenty states there appears to be a total of about 650 defaults of cities and towns of more than 1,000 population. The states with the greatest number of defaulting municipalities are Florida, Michigan, North Carolina, Ohio and Texas. Of the 309 cities with a population of more than 30,000, only eleven with six of their overlapping school districts are in default. If the total debt of these eleven cities were in default, it would represent only 1.8 per cent of the total debt of cities of this population group. Compare this record with defaults on farm and urban mortgages. According to reliable estimates they exceed 25 per cent.

Before constructive measures can be devised, the causes of the present debt difficulties must be known. The primary causes are (1) the overdevelopment of real estate, (2) the absence of adequate debt limitations and (3) the economic collapse of 1929. In regard to the first point, it seems that J. Rufus Wallingford was a back number compared to the pre-depression subdivision developer. Acreage land was bought and cut up into little parcels called lots. One day a city charter was obtained from the state legislature, and on the next day the real estate corporation's officers were elected the city council. Bonds were then issued, improvements were constructed and everything looked rosy. This is a literal recital of what actually happened in some instances. In other cases the subdivisions were annexed to cities. Still other developments were made inside the municipality by using high-pressure methods on the city council. It all demonstrates that development should be orderly, controlled by local and regional planning and expanded at a reasonable rate.

Municipal bond defaults in the future can be prevented in several ways. The first step is to provide some adequate means for limiting debts. In the past these limitations have been expressed in terms of a ratio of the debt to the assessed valuation. This does not take into account many other economic factors in the community. The new debt limits should be based on the rate of increase in the debt, there should be a restriction of the purposes for which bonds may be issued, and there should also be some relation between tax delinquency and the ability to issue bonds. A debt limit should be determined which will be all-inclusive and which cannot be evaded by subterfuge such as the creation of new and overlapping municipal corporations, exemplified by the independent park boards of Cook County, Ill., and the special assessment districts that are almost universal.

There must also be some legal machinery for dealing with municipalities that default in debt payments. Some state agency should be created which has the power to deal in a summary fashion with the defaulters, and with the further power to adjust the debt if it seems impossible to meet the obligation at any future time. Such remedies might well be patterned after the Ontario Municipal Board Act of 1932. In summary, to preserve municipal credit there must be an intelligent restriction of local debts and adequate remedies for the holders of municipal securities.

THROUGH the elimination of tax-anticipation borrowing it would be possible for the cities of the United States to save at least $40,000,000 a year in interest charges. To effect this saving, it will be necessary to bring the tax-collecting and tax-spending periods into proper adjustment.

Better tax-collection procedure is needed everywhere. The principal weakness at present lies in the lax administration of the existing statutes. Payment of taxes in installments would effect a much-needed reform.

The growing use of serial bonds for long-term debt is commendable. It discourages excessive bonding and avoids the hazards of sinking-funds.

One of the contributing factors to the present financial plight is the poor quality of municipal accounting in the past. The failure of public officials to render an intelligible report of their activities and expenditures is partly responsible for the suspicion and disrespect with which citizens look upon their governments.

State control is no cure-all for municipal financial troubles. No state government can be more intelligent than are its component parts. Numerous cities are better managed than the states of which they are a part.

State control

State control of local finances is advocated by many groups as a cure-all for municipal financial troubles. The weakness of this remedy lies in the fact that no state government can be more intelligent than are its component parts. In general, state governments have made no greater progress toward good fiscal management than the cities themselves. As a matter of fact, in many states there are well-governed cities that furnish a model that the state might well copy.

There is a definite field, however, within which the state should correlate and supervise local financial affairs. A state agency should gather complete statistics on the costs of local government. Every municipal jurisdiction should report to this agency the debts of a permanent nature which it has incurred, and bonds should be issued only within the restrictions that the state considers necessary. Furthermore, there should be a state department to which city officials could go for cooperative and friendly assistance. The role of the state should be that of an advisor and coordinator, but not that of a dictator.

Need of advance planning

Just as curtailed municipal improvements during the World War brought about a great increase in public construction subsequent to 1922, so the end

of the present depression will without question see renewed activity in the building of schools, sewers and other municipal facilities. The present standard of living in the United States cannot be maintained without continuous and intelligent addition to the physical facilities of its municipalities. It is indeed unfortunate that construction must now be curtailed at a time when it should be expanded, but this is due in part to the conservative attitude of our people, the misconceived idea of the use of public credit and the lack of advance planning of public works. The Federal Stabilization Board has accomplished much with respect to the building program of the national government, and it is trying to extend its helpful activities to coordinate the construction work of local governments. But it must not only assist them in the planning of their physical needs, it must also consider the necessity of financing these improvements during a period of deflation.

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Improving Municipal Credit

IT IS unlikely that reserves will be accumulated by cities during good times to construct improvements when industry is slack. Therefore, methods must be devised for using the public credit for the construction of public works even at a time when credit for other purposes is curtailed. This involves the establishment of a market for municipal securities during depression periods. The lack of such a market can work great hardship. The city of Chicago, for example, has no bonds outstanding for the construction of public schools, all of the buildings recently constructed having been financed by current revenues. Yet twelve large school buildings in the city now stand idle in various stages of completion because it is impossible to finance them. No work has been done on them for months and no one seems to know when they will be finished. The depreciation of the buildings in their present state of course will represent a tremendous loss to the community. It is certainly not a credit to our financial system that it forces work to stop on these projects while seats are needed in the city for 48,000 high-school children. This is a glaring example of what lack of planning and of financial resources can do.

Perhaps one of the best ways to encourage the use of public credit is through the sale of revenue bonds secured by a mortgage on a self-liquidating municipal project. It is well known that a large proportion of American cities today needs to build sewage-disposal plants, and many of them could add to their facilities for water, electric lights and gas. Although municipal revenue bonds in the past have been considered inferior to general tax bonds, they have stood the test of the depression remarkably well. If they are secured by a trust mortgage which conveys the right to take over and operate the property in case of default, they should be just as satisfactory as other utility bonds or municipal tax bonds. Their use may be one means of providing the desired market.

Another factor that might contribute to the expansion of municipal credit on a sound basis would be to provide that all municipal bonds be a lien not only upon the real estate of the city but on its total municipal income. There is no good reason to exempt the revenue of non-tax sources from use for paying debt obligations. Furthermore, if municipal revenues in the future come in a greater proportion from sources other than the real estate tax, such a provision will be necessary.

Municipal credit is sound and should continue to be so. This statement is made with the full knowledge of the defaults that now exist and of the efforts of some communities to avoid payment of their obligations. The first guarantee of the payment of municipal debts is the inherent honesty and fairness of the American people, and our whole national experience shows a net loss to investors in municipal bonds of a negligible fraction of their investment. No extensive or general repudiations or defaults have ever brought about any losses that have spread over a wide area or have amounted to any considerable total. Even the present performance of municipal bonds warrants a favorable rating.

DURING the current year a series of articles has appeared in these pages on the subject of municipal costs and administration in the light of the continuing tax-reduction publicity. The series closes with the present article dealing with financial practices. The articles that have already appeared are:

Are Our Cities Bankrupt?
Feb. 25, 1932, p. 274

Financial Embarrassment of Cities
March 3, 1932, p. 321

Facts About Municipal Costs
March 10, 1932, p. 365

City Services at Low Cost
March 31, 1932, p. 458

How Can Costs be Lowered? I
July 7, 1932, p. 13

How Can Costs be Lowered? II
July 14, 1932, p. 46

It has been stated in an earlier paragraph that the defaults in the larger cities amount to less than 2 per cent of the total bonds outstanding. This is extremely favorable when compared with any other class of obligation except the securities of the national government. On Nov. 29, 1932, prices of bonds listed on the New York Stock Exchange showed American Telephone and Telegraph 4½'s, due in 1939, selling at 106; Baltimore & Ohio First 4's, due in 1948, at 76½; Erie General 4's, due in 1996, at 43½, and its 5's, due in 1975, at 25⅝; New York Central Refunding 4½'s, due in 2013, at 44½; and Stevens Hotel 6's A, due in 1945, at 18½. Midwest Utility 5's, due in 1935, sold on the New York Curb Exchange at 8⅞. These represent large issues of bonds, and a change in the price in any of them means a tremendous shrinkage in the value of the holdings of an extensive group of investors. On the same date, municipal bonds such as City of Buffalo 3.80 per cent bonds, due 1938, were selling at 101.06; State of Michigan 4½'s, due 1957, at 100.89; San Francisco Water 4½'s, due 1938, at 101.98; Highland Park, Michigan School 4½'s, due 1954, at 88.85. Needless to say, other municipal issues could be found selling at a very low price or begging for a market, but the same might be said of hundreds of issues of real estate bonds as well as some issues listed on the New York Stock Exchange.

Their exemption from federal income taxes undoubtedly accounts in part for the popularity of municipal bonds. This alone, however, cannot be responsible for the large difference in yield between municipal bonds and other bonds, a point which is well illustrated in "Cost of Government in the United States, 1929-30," by the National Industrial Conference Board. Their report shows that in 1930 the yield of municipal bonds was lower than the yield of other groups by the following percentages: railroads, 7.29 per cent; industrials, 17.78 per cent; utilities, 12.47 per cent; 60 high-grade bonds, 9.96 per cent. This should be sufficient evidence of the esteem in which municipal bonds are held by investors. Can it be that their opinion has changed as greatly in the past few months as casual and uninformed observers would have us imagine? And can it be that the intrinsic value of municipal bonds has decreased to any great extent?

Fear and fancy, not cold fact, now impair municipal credit. Defaults can and must be prevented—by adequate state supervision, by intelligent and honest action on the part of local officials, by the limiting of debts to necessities within the ability to pay, and by advance planning of public works. Yet the facts clearly indicate that municipal credit is fundamentally sound when judged by its records, its trends and its inherent qualities.

Efficient Pile-Casting Yard for Highway Bridges

Gantry crane, with six-point grappling-beam pick-up, and welded-steel forms are features of pile plant for Great Egg Harbor structures in New Jersey—Forms vibrated during casting

A CONCRETE pile-casting yard with notable features was provided to mold and handle the 1,176 piles for three bridges on the state road giving direct connection across the ocean inlet (Great Egg Harbor) separating the mainland and the shore resort of Ocean City, N. J. This yard had a seperate molding platform for each pile, vibrators were used to compact the concrete, the pile forms were made up of welded-steel sections, and a particularly effective grappling truss, with six adjustable grabs, handled the piles. The bridges except a few spans of one providing a navigable channel are concrete deck and pile-bent structures of familiar type.

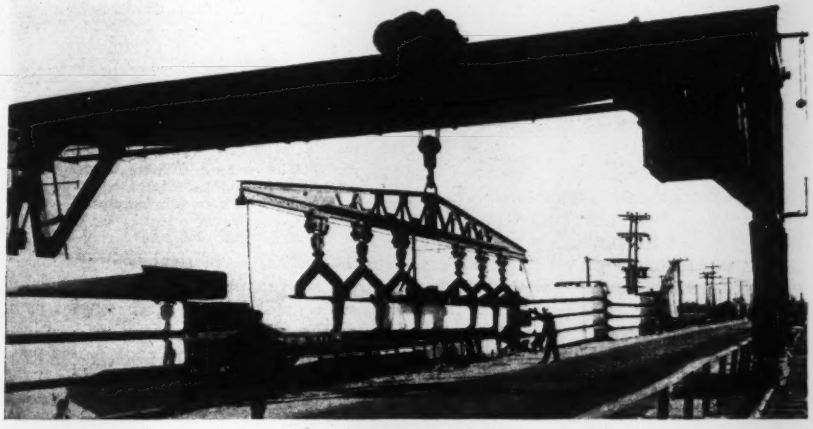


Fig. 1—Gantry crane and distributing truss, with six hangers for handling and loading piles in the casting yard.

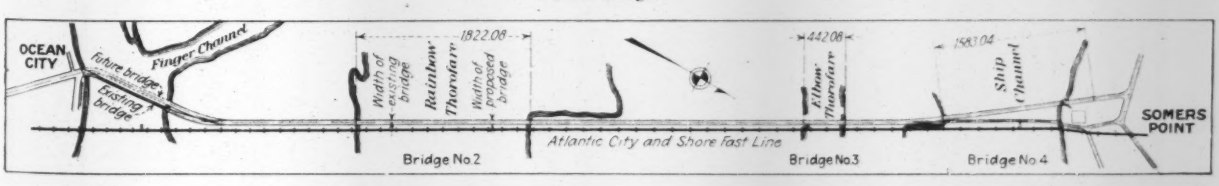
Bridge location and design

The inlet crossing, showing the location of the bridges, is indicated by Fig. 1. The land portions are low, flat sand bars, and no part of the road is greatly above tide levels. As indicated, three bridges, Nos. 2, 3 and 4, are included in the present operation; bridge No. 1 is planned for future construction. The three bridges in the present operation have an aggregate length of 3,847 ft. and replace old timber pile and deck structures with 22-ft. roadways that had become far too light and narrow for modern traffic. The bridge leading from the Somers Point mainland over the ship channel is on a new alignment, involving no problem in handling traffic. The other two, crossing Rainbow and Elbow thoroughfares, are close to the old alignment and require the old bridges to be cut down to a 20-ft. roadway and the new bridges to be built half-width adjacent to the old structures, then the traffic transferred to the completed portion, and the remaining half built as shown by Fig. 2.

Two of the bridges and most of the third, as stated, consist of precast pile bents, concrete caps and T-beam concrete decks with a 40-ft. roadway. Each bent contains 8 piles 22 in. square, six driven vertical and the outer two on a batter. The bents are spaced 20 ft. c. to c. The deck is made up of eight longitudinal beams 18 in. wide, carrying an 8-in. structural slab topped with a 2-in. bituminous concrete wearing surface. A concrete railing of precast units is carried on each side by a cantilevered curb. The piles varied in length from 40 to 68 ft. Numerous test piles and careful plotting of the depth of water enabled the pile length for each bent to be determined in advance.

The bridge over the ship channel contains a 71-ft. single-leaf bascule span. For appearance the adjoining span on the trunnion end is identical in appearance, though fixed. Because of the depth of the water the approaches to the lift span consist of eight deck plate-girder spans of 70 ft., resting on high concrete piers. Each span consists of three longitudinal plate girders, carrying 24-in. floor beams. All of the girders and beams, including cross-bracing, are incased in concrete, except on the bascule and one adjoining span. The lift-span floor is asphalt plank laid diagonally over 6x10-in. timbers. The remainder of this bridge, which is 1,583 ft. long, is concrete pile and deck construction.

Fig. 2—Diagram plan of state highway bridges across Great Egg Harbor, constructed to replace light and narrow timber trestle bridges.



Pile casting

The pile-casting yard was laid out on the island separating Elbow and Rainbow thoroughfares. An interurban railroad parallels the highway across the island, leaving a strip of low-lying ground 30 ft. wide between the tracks and the concrete road slab. This area was filled in with sand to bring it to the same grade as the roadway and was surfaced with cinders.

Because of the use of vibrators during pouring operations, the wooden platforms upon which the piles were cast were designed to take single piles only. The yard was laid out in bays, one bay containing casting platforms for ten piles and the next bay being used for curing and storage. Each platform consisted of 2x8-in. flooring located clear of the filled ground, supported by two 2x6-in. stakes and a 3x8-in. cap every 3 ft. At 3-ft. intervals ¼x4-in. iron straps were screwed to the bottom of the floor panels, extending beyond the floor and punched at each end to receive pins holding the side forms in place (Fig. 5).

The all-welded steel side forms (Figs. 4 and 5) of ⅜-in. plate were made up in panels 15 ft. long, with a few 6- and 9-ft. lengths for adjusting the form to varying lengths of piles. The plates were bent at top and bottom to form the chamfered corners of the piles, a 1½x1½-in. corner angle backing up the bent portion. The side forms were held across the top by split yokes of 2x2-in. angles, the horizontal legs that bolted

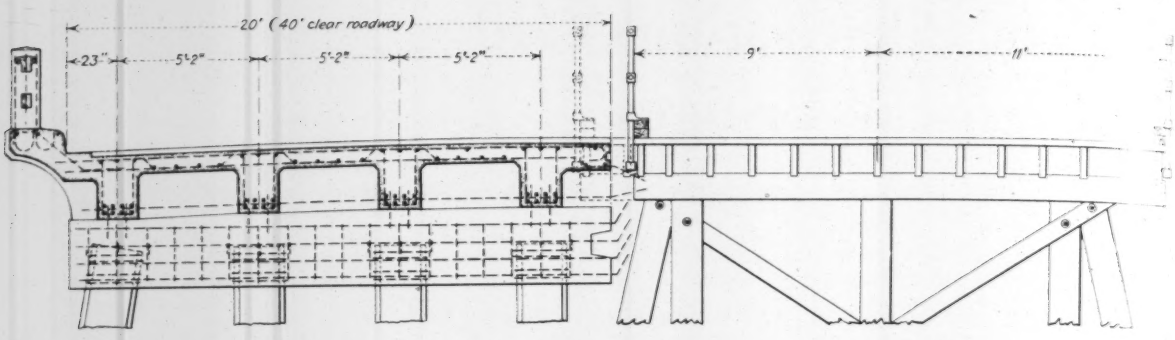


Fig. 3—Section showing type of new structure and method of constructing it half at a time alongside the old timber trestle.

at the center being welded to the vertical legs, which were in turn welded to the side plates acting as stiffeners. The plates were further stiffened by a horizontal tee.

The forms were held in place by pins dropped through holes punched in the outstanding leg of the tee, through a punched plate welded to the bottom of the side yoke and through the holes in the straps extending from beneath the floor. Wood-form units were used for the pile tips, which converged from 22 in. square to 8 in. square in the lower 28 in. of length. The head or butt-end form was a wood diaphragm that could be moved within the steel sections to form the proper length pile.

Reinforcing cages were built up in place on the platform before the side forms were set, with the aid of steel cradles that spaced the longitudinal bars properly. Each pile contains twelve longitudinal $\frac{7}{8}$-in. round bars and $\frac{1}{4}$-in. hoops spaced 3 in. c. to c. A $\frac{7}{8}$-in. dowel in the butt end was left out until the pile was driven, though a hole was cast for it.

A very dry concrete mix, 1:1.23:2.5, with 4 gal. of water per sack of cement, was used. The concrete was mixed in a paving mixer placed alongside the set of piles to be poured and was handled by a crane to the forms in a bottom-dump bucket. The procedure was to start at one end and fill the form completely as pouring progressed. Electric vibrators were clamped to the forms during pouring. An average day's concreting schedule was 750 lin.ft. of piling.

Fig. 4—Assembled steel form for pile with one panel removed to indicate method of assembling the form.

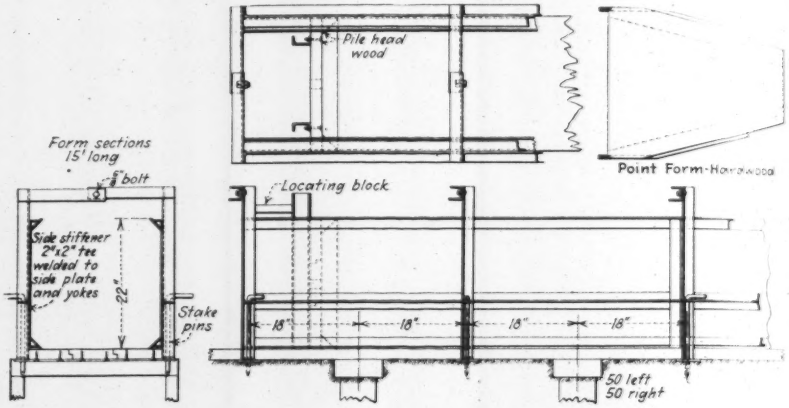


Fig. 5—Pile side forms were steel-plate panels with welded stiffeners and braces, assembled in various lengths according to the length of pile required.

The side forms were removed the next day. The piles were kept wet for seven days, then were transferred from the platform to storage piles. Before being taken to the driver the butt ends of the piles were painted with five coats of water-gas tar to a point well below the low-water lines.

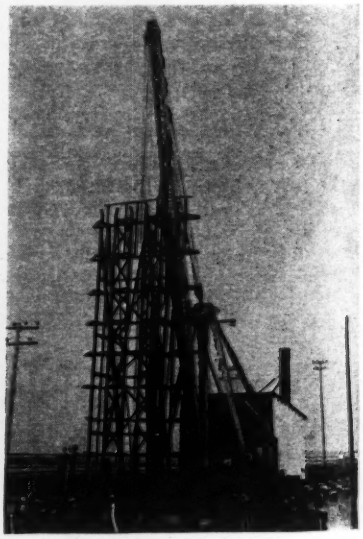
An ingenious pick-up system was a feature of the gantry crane used in handling the piles. This consisted of a truss carrying six hangers (Fig. 1) adjustable as to position. Each hanger carried a set of tongs that fitted around the pile, gripping it from underneath. The tongs were held closed by links and wedges when a pile was being lifted.

The piles were allowed to cure at least 60 days before being driven. They were transferred to the driver by trucks and long trailers, and for the ship channel bridge were unloaded onto barges by a crane.

Two skid drivers (Fig. 6) were used, each traveling over piles already driven.

The drivers could work on half a bent at a time, being equipped with gang leads for three vertical and one batter pile. As each half-bent was completed, it was cross-braced with angles until after the driver had passed by. In handling the piles to the leads a two-point suspension was used for piles under 50 ft. and a three-point for those over that length. A single-action steam ham-

Fig. 6—Piledriver on skids with four leads drove piles while traveling on top of piles already driven.



mer did the driving, the pile heads being protected by wooden caps.

The forms for the pile caps were made up of wood panels, care being taken to provide a tight fit around the piles to prevent leakage. The side forms were held by steel yokes placed across the top. The caps were poured far in advance of the deck building.

A feature of the deck construction was the use of special steel forms for the overhanging cantilevered curb sections. Anchor bolts for holding the forms were cast in the ends of the pile caps. The steel forms were held by these anchors through steel brackets. The deck and T-beam forms were carried by longitudinal steel beams, blocked up on the pile caps.

The piers for the long girder spans and bascule over the ship channel were built in open steel-sheetpile cofferdams and were founded on wood piling, long enough to be driven in the dry. The piles were cut off to grade after all for one pier had been driven, and the cut-off lengths were cut up into form lumber on the job. Tremie concrete was used to seal the cofferdams, the seals ranging from 5 to 10 ft. in depth. As the ship channel bridge was removed from the existing roadway, temporary timber bridges were built alongside the new bridge to carry piledriving cranes and concrete-placing equipment.

Forms for the main-girder incasements were hung by $\frac{3}{8}$-in. rods hooked over the top of the girders. These rods were nicked with a hacksaw on four sides about $2\frac{1}{2}$ in. above the soffit of the girder. After the forms were stripped, a quick turn with a pipe wrench broke off the rod at the nicked point, removing the objection of steel remaining close to the surface of the concrete. On the deck slab of the girder spans transverse expansion joints were made by using corrugated cardboard strips.

The bridges were built by the New Jersey state highway commission under the direction of Morris Goodkind, bridge engineer. C. H. Weller was resident engineer for the commission. The contract was held by the Eastern Engineering Co., Atlantic City, N. J. Charles A. Eaton, president, was in charge, assisted by W. R. Buie, construction engineer. Piledriving was sublet to Grier-Lawrence Construction So., Statesville, N. C., with H. P. Grier, Jr., in charge.

Extensive Use of Light Railways Advocated for Chinese Republic

AN EXTENSIVE system of railways of light construction and low cost, but of uniform gage, is needed for the development of China, according to a report made by Arthur M. Shaw as consulting engineer for the Chinese National Construction Commission. As to the planning of such a system, it is stated that under peaceful domestic conditions and freedom from outside interference, almost any railway could be operated at a profit and with benefit to the district served. It is pointed out that although the Peiping-Hankow Railway did not follow established lines of commerce, it was a profitable investment from the beginning.

For the proposed light railways a 35-lb. rail is recommended as being the minimum section on which ordinary equipment can be handled. It has an important advantage at present, also, in that such rails can be purchased on an unrestricted competitive basis, while for heavier rails a minimum standard price is maintained by rail manufacturers. However, this weight is recommended only for lines of very light traffic; 45-lb. rails are desirable and economical for even moderate traffic. Thus Mr. Shaw states that: "The additional investment for the heavier rail will (up to a reasonable limit) yield greater net returns on a line of moderate traffic than will a similar amount invested in almost any other single item, excepting only drainage and reduction of controlling grades."

Since a light railway may be converted to standard construction at a small increase in ultimate cost, it is recommended that the light (35- to 45-lb. rails) and intermediate (60- to 75-lb. rails) standards of construction should be adopted for all new lines of the near future, excepting those few lines which will be required immediately for heavy service. For these last, rails of 85-lb. and heavier weight would be used.

By following these principles a line of given length may be built for less money, or a given investment will build a greater length of line and serve a greater area. As reconstruction becomes necessary, the lighter material released would be available for the construction of new lines.

As to the question of width of gage, it may be assumed that the standard gage of 4 ft. $8\frac{1}{2}$ in., which has been adopted for the existing lines, will be adhered to in future lines that are to form part of the general railway system. For light railways a gage of $2\frac{1}{2}$ or 3 ft. or 1 meter is frequently suggested, but, says Mr. Shaw, the objections to narrow-gage lines are so many and so serious that such lines should be considered only for the rare cases in which the advantages are substantial and certain, and where the objections may be reduced to the minimum. Comparative estimates for a light railway of standard gage and narrow gage (width of latter not stated) total $61,487 and $60,460 per mile, a difference of only $1,027. A fundamental objection to break of gage in a connected system of railways is the cost and delay incidental to transfer of freight. Furthermore, the advantages of narrow as compared with standard gage are usually over-estimated.

In discussing the features of light railway construction, Mr. Shaw points out that the probability of future improvement to adapt them to conditions of heavier traffic will influence their location and the design of structures. Reasonably good alignment is important in any case. Curves as sharp as 230-ft. radius may be negotiated by standard-gage equipment as safely as by narrow-gage equipment, while with increasing radius the safety factor of the former is increased. Heavy grades may be more objectionable on a light railway than on a heavily built line, which can introduce powerful locomotives for special conditions. On the other hand, broken grade lines which would be unsuitable for long and fast trains may be permissible for short slow trains and may be planned for revision into longer and more regular grades when required.

Long culverts without head walls can be built as cheaply as shorter culverts with large head walls and will provide for increased width to fill for widening the roadbed or for grade revision, which latter usually includes raising the grade line on fills crossing the valleys. Pile and frame trestles can be built to permit the later placing of an extra pile or post in each bent and an additional pair of stringers, which work can be done under traffic. For bridges of long span each must be a problem in itself. The substructure should be suitable for heavy loading, since future reconstruction would involve great expense. The initial superstructure may be light or heavy, according to whether heavy loading will be required at some indefinite time or in the comparatively near future.

Financing railway development in China will be a difficult problem. Construction by the government with its own funds is considered to be impossible. If private capital is to become interested on a large scale, reasonable return on the investment must be offered and can best be secured through private ownership and management. Two principles as to the relation of government and private interests are enunciated by Mr. Shaw: (1) a privately owned railway, operating with a minimum of governmental supervision and restriction, is more efficient than a railway which is owned and operated as a government enterprise; (2) civilization will not permit a railway system, which so vitally affects national welfare, to be exploited with regard only to the profits accruing to private capital.

Friction Piles in Muck Sink Evenly Under Load

THE CONSTRUCTION of the dry-seal waterless gasholder at Syracuse, N. Y., in 1931 called for a foundation on a deep bed of alluvial soil and muck. In view of the unique character of the holder structure and operation, as described in *Engineering News-Record*, March 31, 1932, p. 466, close consideration was directed to the foundation conditions and to the design of a foundation that would be stable under these conditions. However, in the year that the gasholder has been in operation it has settled about 2¼ in. This settlement has been so nearly uniform that no harm to the structure has resulted, but its occurrence presents a phenomenon that is of much interest to note.

Briefly, the foundation consists of a ring of square concrete footings spaced evenly around a circle 188 ft. 10⅜ in. in diameter and connected circumferentially by a wall. The footings, which carry columns, are supported on piles. Inside the foundation ring is a floor of concrete laid in slabs separated by expansion joints. The construction of these joints is indicated by the detail in Fig. 1.

In planning the foundations, borings to a depth of 157 ft. disclosed no good bearing soil (see tabulation); alluvial soil and black muck persisted to the full depth of the borings. The nature of the material is somewhat indicated by the fact that, in driving, the piles would sink 40 to 50 ft. under the weight of the hammer. Under the conditions friction-pile support was decided on, and 90-ft. composite piles, 60 ft. wood and 30 ft. concrete, were driven according to the usual practice of the contractor, the Raymond Concrete Pile Co., New York, N. Y. After the wood pile was driven full length it was capped with a steel shell and core and driven with the shell to full depth. The core was then withdrawn, reinforcing rods were set and the shell was filled with concrete.

After the first group of piles had been driven one was selected at random for test loading to determine whether the tentatively planned number of piles per footing should be changed. Careful loading and instrument readings on the test pile indicated its maximum carrying capacity to be a little under 30 tons. However, it was decided to fix the pile load at 8 tons, giving a factor of safety of about four. The pile plan was redesigned accordingly, and the foundations were installed without any unusual event.

Level readings were taken on each of the 36 footings from the start of work and these have been continued. Fig. 2 shows the settlement on six columns from May, 1931, to May, 1932. The curves show a maximum settlement of 0.185 ft., or about 2¼ in. For the final three months the settlement was only about ⅛ in., indicating that the structure is coming to rest. The curves also indicate how uniform the settlement has been.

REPORT ON SOIL CONDITION AT A POINT ADJACENT TO 6,000,000-CU.FT. GASHOLDER OF SYRACUSE LIGHTING CO.

Elevation Below Grade From Ft. In.	To Ft. In.	Description of Soil
0 0	19 0	Cinders, soda ash (semet-solvay waste)
19 0	38 6	Soft silt, sand and shells
38 6	69 8	Soft silt and little fine sand
69 8	102 0	Soft gray clay and fine sand
102 0	136 0	Soft brown clay and little fine sand
136 0	158 0	Medium brown clay and little fine sand

Note — Soft brown clay three blows per foot. Medium brown clay ten blows per foot.

Fig. 1—Sections of column footings and ring-wall foundation for gasholder located on deep bed of soft soil.

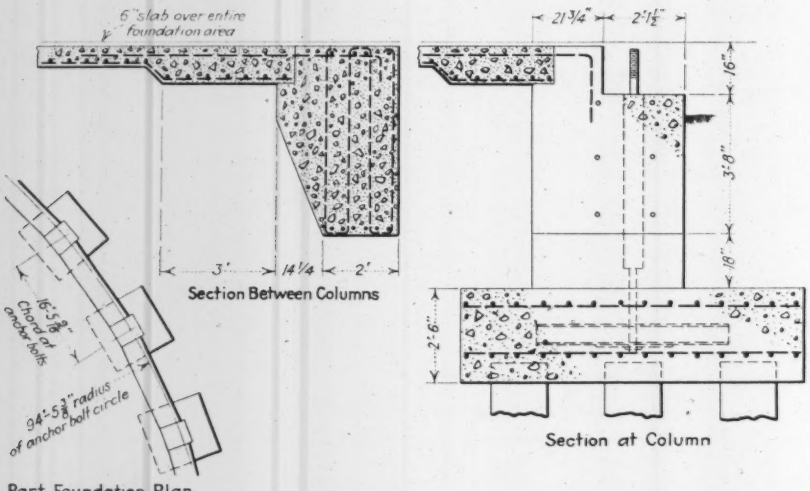
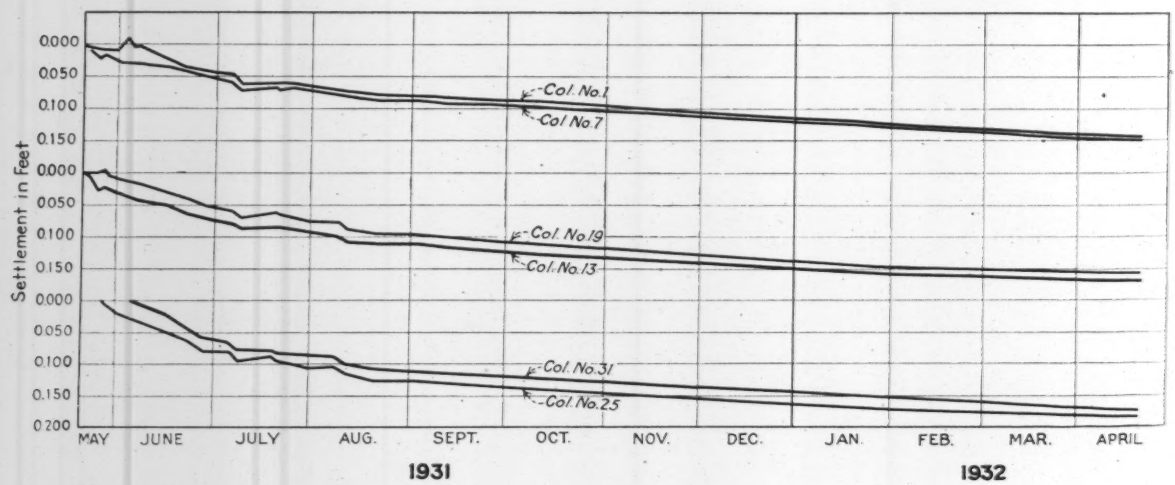


Fig. 2—Settlement curves for six columns equally spaced around ring of footings for Syracuse gasholder foundations.



Cleveland Again Bridges Cuyahoga Valley

Lorain-Carnegie bridge of thirteen cantilever truss spans, and fill and trestle approaches supplements two existing crossings—Copper-bearing silicon steel used

THE OPENING to traffic Dec. 1 of the new Lorain-Carnegie high-level bridge over Cuyahoga Valley in Cleveland provides an important traffic connection between the western and eastern parts of the city and serves as a bypass for through traffic south of the main business section. It will also relieve the traffic on the Detroit-Superior bridge as well as on the Central Viaduct whose eastern terminus practically coincides with the eastern terminus of the new bridge.

Although the bridge was planned for two decks, only the 60-ft. wide upper deck has been installed. The lower deck when built will carry street railway tracks and two 18-ft. trucking lanes. The total length of the bridge proper is 4,490 ft., of which that part over the valley comprises 2,886 ft. and consists of thirteen steel cantilever truss spans, alternate spans carrying suspended trusses. Four lines of trusses are used, inasmuch as it was desired to separate the future lower roadway into three distinct lanes, the street railway to occupy the space between the two center trusses. Not only the Cuyahoga River but Canal Road, an important street, and the tracks of the Wheeling & Lake Erie, the Baltimore & Ohio, the Big Four and the Erie railroads are crossed. Location of the piers for the new bridge was dictated largely by consideration of property damage to these facilities and to contiguous industrial plants. The final placing of the piers was fairly uniform, however, spans gradually increasing in length as the river is approached. Thus the eastern span is 132 ft. and the river span 299 ft. Shipping clearances over the river are 93 ft. vertical and 180 ft. horizontal.

The eastern terminus of the bridge being at the intersection of Central Ave. (a continuation of Carnegie Ave., a major east-west artery) and Ontario St., one of the most important north-south streets in the city, presented a most difficult problem. The future lower deck caused further complications. A two-stage development was the solution. The first stage, which will be adequate for the present, involved moving one of the curbs of Central Ave. about 80 ft.

Fig. 2—Erecting the 299-ft. span over the Cuyahoga River. All trusses are cantilevers carrying suspended portions.

Fig. 1—Lorain-Carnegie bridge over Cuyahoga Valley in Cleveland provides a bypass for through traffic south of the business district, relieving traffic on the Detroit-Superior bridge, whose arches are visable in the distance to the right of the monumental pylons.

to the north, making this roadway wide enough to accommodate, without interference, traffic from the new bridge and from the existing Central Viaduct. In the second stage a traffic circle is contemplated to serve all traffic from the two bridges and the intersecting streets, with all street railway tracks underground.

The cantilever trusses of the Lorain-Carnegie bridge differ from the usual design in that the lower chords are curved to give a more pleasing appearance—at a cost of 6 per cent more steel than would have been required by straight chords. Other architectural expedients included carrying the piers up to the roadway by means of concrete fascia walls and pedestals between the trusses, the use of stone and aluminum-grill railings and the building of two massive stone pylons at either end of the main bridge.

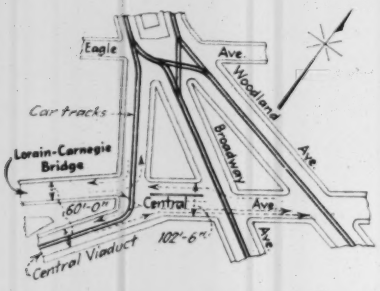


Fig. 3—East plaza, showing how Central Ave. has been widened to handle traffic from both Lorain-Carnegie bridge and Central Viaduct without interference.

Foundation conditions encountered were typical of the Cuyahoga River valley and consist of alternate layers of river muck, fine and coarse sand, some gravel and much clay. All piers are carried on 16-in. square precast concrete piles with the exception of the river piers, for which timber piling was driven, and one pier that was founded on a concrete mat on the clay. These timber piles for the river piers were driven to practical refusal in lengths of 32 ft., with their tops at El. —37.5. On top of the timber piles a concrete mat, 33½x100 ft. in plan and 7 ft. thick, was poured. Hollow shafts 16x20 ft. at the base, tapering to about 8½x17 ft. under the coping, are carried on the mat. These shafts have walls 3 ft. thick at the base, 2 ft. thick at the top and are 114 ft. high. During construction steel sheetpiling cofferdams 38x104 ft. in plan and about 60 ft. deep were driven, permitting all concrete to be placed in the dry. Driving the concrete piles for the other piers proved a difficult task, and water jets were extensively used. These piles were also capped with a mat from 6 to 8 ft. thick.

In designing the superstructure, live loads were used based on eight lines of vehicular traffic, two electric railway tracks and two 6-ft. sidewalks, giving a load equivalent to 83.2 lb. per sq.ft., exclusive of wind. The total dead load on the bridge when the lower roadway is completed will be about 34,000 lb. per lin.ft., and the total live load about 13,500 lb. per lin.ft.

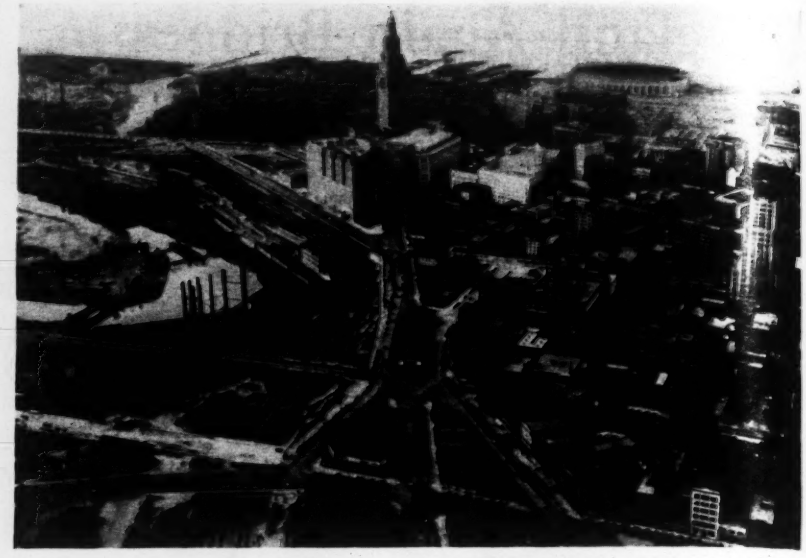


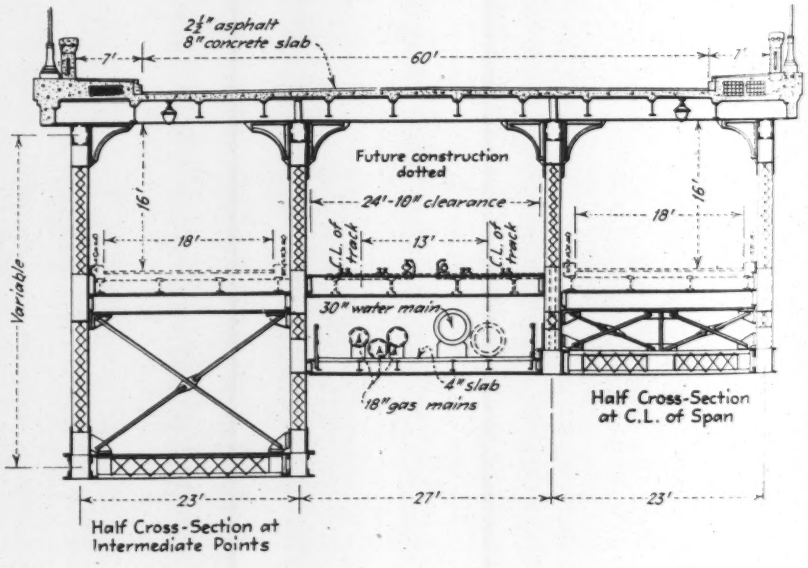
Fig. 4—East plaza of Lorain-Carnegie bridge before widening of Central Ave., showing location of bridge with relation to Cleveland business section.

Copper-bearing silicon steel

The main trusses are 25 ft. minimum depth to about 50 ft. maximum. In general, the lower chords are composed of two 30-in. plates and four angles; the upper chords of two 24-in. plates and four angles, while web members are two plates 16 to 24 in. wide and four angles, all double-laced. Material in main members is silicon steel, and all other members are carbon steel. Both carbon and silicon steel conform to standard A.S.T.M. specifications except that 0.2 per cent of copper was added for corrosion resistance. Working stresses on carbon steel were 18,000 lb.; on silicon steel, 25,000 lb. Suspended spans, of which the longest is in the river span, comprising six out of twelve panels, are secured to the upper chords of the cantilevers; between the lower chords a strut is inserted useful for lateral loads only.

The roadway steel consists of I-beam stringers on 6 ft. 10-in. centers framing into transverse I-beams resting directly upon the top chords. The roadway is paved with 3 in. of asphalt carried on a concrete slab, reinforced with fabricated units and using lightweight aggregate. The curb has a total height of 17 in., the face toward the roadway being offset 4 in. at a height of 10½ in. above the gutters, forming a 6-in. step. This provides sufficient depth of face under

Fig. 5—Cross-section of Lorain-Carnegie bridge. Lower deck for trucks and street cars is deferred for future construction.



the sidewalks to take care of necessary conduits. The curbs are of granite.

Contractors were as follows: river piers, Walsh Construction Co.; other substructure, Lowensohn Construction Co.; superstructure, Mount Vernon Bridge Co. Wilbur J. Watson & Associates designed the bridge and supervised its construction for Cuyahoga County, of which F. R. Williams is county engineer and A. M. Felgate bridge engineer. The construction cost of the bridge proper was practically $4,000,000. Real estate and property damage amounted to about $1,400,000. In addition to these amounts, about $1,000,000 has been expended on approaches west of the river, which include separation of grade of Lorain Ave. and Columbus Road, both main thoroughfares. About $1,000,000 of the total $8,000,000 bond issue remains for construction of the traffic circle at the east end of the bridge.

Reinforced Brick Masonry on Dearborn Sewer System

Regulator chamber and dam in old storm sewer, made necessary to fit it for combined flow, are built of brick reinforced with steel rods

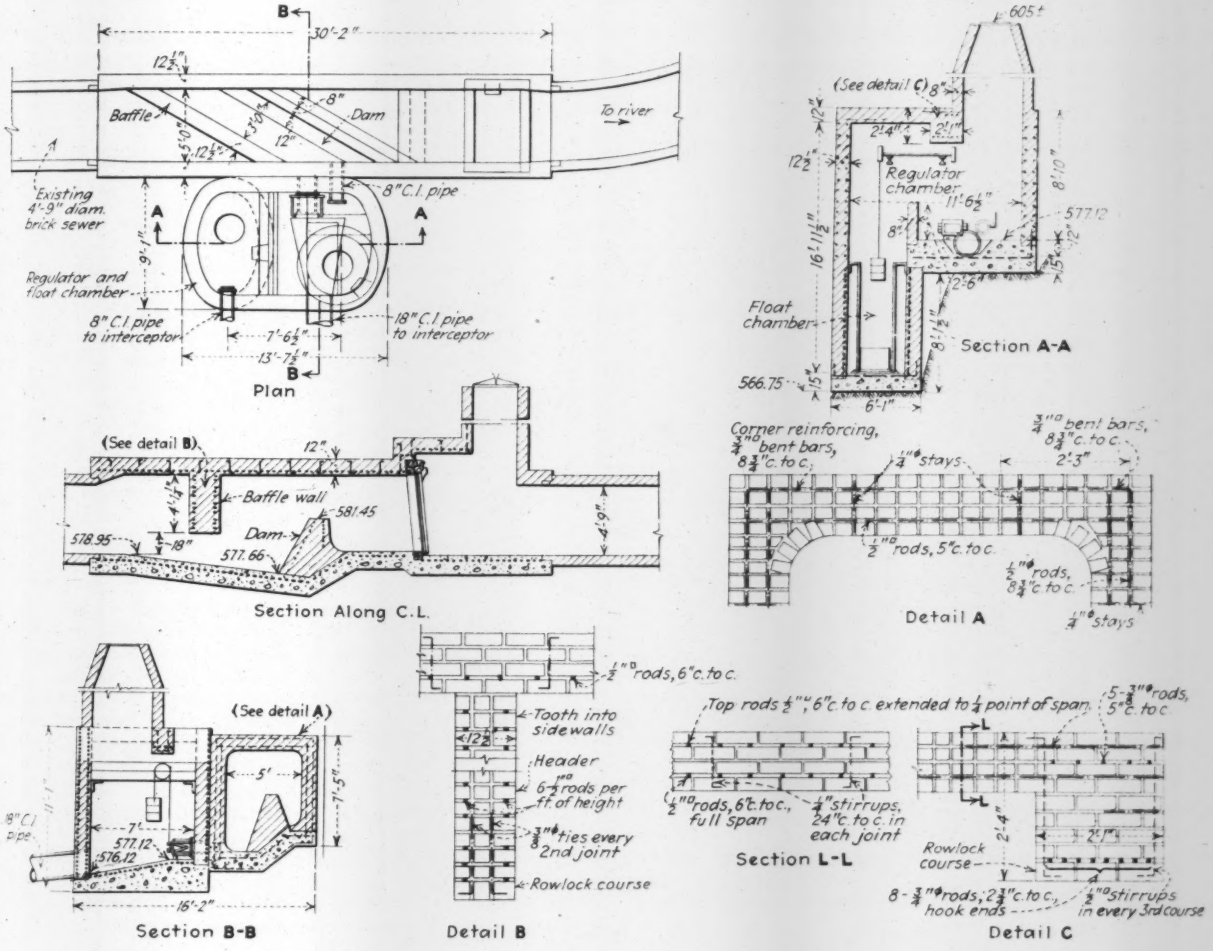
By Charles H. Fork

Engineer, Clay Brick Manufacturers of Detroit, Detroit, Mich.

REINFORCED brick masonry was used on the Dearborn, Mich., sewer system for some special construction required to divert the sewage from an existing sewer to an interceptor connecting with the disposal plant. This old sewer had been used for stormwater only but was to be converted to a combined storm and sanitary drain by the new work. During dry weather all of the sanitary flow will be diverted to the disposal plant. Stormflows will be flushed over a dam in the sewer into a river outlet.

The work, located on Michigan Ave. opposite the engineering laboratories of the Ford Motor Co., consisted essentially of replacing 30 ft. of the existing 4-ft.-9-in.-diameter brick sewer with a rectangular sewer section 5 ft. wide, varying in depth from 4 ft. 9 in. to 6 ft. 10 in. and with invert about 26 ft. below the street; of building a regulator and float chamber at one side of the sewer with bottom at 37 ft. maximum below the street level; of installing a dam and baffle wall in the new section of the

Details of reinforced brick masonry used in a diversion and regulating chamber on the Dearborn, Mich., sewer system.



sewer; and of building a rectangular manhole 3x5 ft. from the top of the sewer to street level. With the exception of the invert of the sewer and the bottom of the chamber, reinforced brick masonry was used for all this new construction.

Design considerations

The regulator and float chamber required side-wall reinforcement against lateral earth pressure, which varied from 600 lb. per sq.ft. at the top to 1,100 lb. per sq.ft. at the bottom. The roof of the chamber, supporting the manhole and a 19½-ft. surcharge of earth, was assumed to carry a load of 2,100 lb. per sq.ft. It consists of beams placed at each side of the manhole and a 12-in. brick slab.

In the sewer section the lateral earth pressure varied from 600 to 800 lb. per sq.ft., and the earth load, top and bottom, was assumed to be 2,100 lb. per sq.ft. The side walls and roof were made 12 in. thick and reinforced for both positive and negative moments. Reinforcement was also placed in the horizontal joints of the manhole, inasmuch as the walls had to resist earth pressure varying from zero at the top to 540 lb. per sq.ft. at the bottom.

Allowable unit stresses (in lb. per sq.in.) used in the design were as follows: reinforcing steel, 18,000; brick, 550; shear without stirrups, 35; shear with stirrups, 75; bond, 110.

In general beam-and-slab construction was laid up so that it was bonded together with brick in one direction and with reinforcing in the other direction. No attempt was made to secure a brick bond across the line of vertical shear. The through vertical joints gave space for vertical stirrups or bonding ties, and these were used in the slabs to give additional bond between the horizontal courses. In the walls of the chambers the brick was laid up with alternate stretcher and header courses.

Construction

Construction work was carried on in an open cut, the float and regulator chamber being constructed first. This latter permitted the diversion of water from the existing sewer through the chamber while the new sewer section was being constructed. After the reinforced-concrete bottoms had been poured, bricklaying for the walls proceeded in the usual manner, the horizontal reinforcing rods being well slushed in with mortar. Forms were necessary only for the beams and slabs. Beam stems were built up to the bottom of the slab, the bottom course of the slab was laid, the slab steel and the vertical bonding ties were installed, a slushy mortar was poured over the rods, and the next course of brick was shoved in place. The slabs being 12 in. thick, four courses of brick with two layers of reinforcing were used.

In building the sewer section the vertical steel in the walls and the dam was installed, and the brick construction was carried up to the under side of the slab. The centering for the slab was then completed, and the slab brick and steel were placed.

Common brick was used throughout. Tests showed the strength to average 2,100 lb. per sq.in. when tested flat and the absorption to average 22 per cent. A 1:3 cement mortar with 15 per cent lime was used. The brick was well soaked with water before being delivered to the bricklayer. For the walls the mortar was kept just thin enough to prevent floating. For the slab it was made a slushy mass above the bottom course. A ⅜-in. joint was used in the walls of the chamber where the steel was laid in horizontal courses.

Placing 610 cu.ft. of brick masonry (8,900 brick) in the regulator and float chamber required 64½ bricklayer hours, including time required for plastering the walls with ½ in. of cement plaster. In the sewer section, including the dam and baffle wall, 81 bricklayer hours were required, including also the plastering of the side walls and the top. There were 780 cu.ft. of brick masonry in this structure, which required 11,400 brick. For the manhole 19 bricklayer hours were required, representing work on 225 cu.ft. of brick masonry (3,600 brick).

In general, two helper hours were required for each bricklayer hour except in the manhole, which required one helper hour for each bricklayer hour. The mortar was machine-mixed and chuted down the hole, and the brick was lowered with a portable crane.

Design and construction supervision were in charge of the engineering department of the department of public works, Frederick R. Storrer, city engineer, and J. W. Coale, field engineer. Blanck & Gargaro were the contractors, with Edward Miller as superintendent.

Water Rates and Construction Programs Should Be Coordinated

THE RELATION between water rates and the annual waterworks construction that should be carried out is a definite figure which depends on population growth. L. R. Howson, in a paper recently presented to the Wisconsin section of the American Water Works Association, gave the following basic figures: The annual population increase of the normal American city is 3 per cent. Waterworks properties are valued at $40 to $50 per capita. Expansion of facilities, therefore, should be at the rate of $1.20 to $1.50 per year per consumer. As the average waterworks income is $6, a sum equal to 20 to 25 per cent of the income is required to be invested annually to keep the plant abreast of growing requirements. Some states—Ohio, for example—specifically recognize this interrelation of revenues and construction expenditures by exempting from the indebtedness of the city all water bonds paid from service charges.

It is desirable for every waterworks to be self-supporting and self-perpetuating. To do so, rates must be adequate to service bonds or to provide for construction from current revenues. In either case construction should be so programmed as to require few rate adjustments. In the long run both methods of financing cost the consumer the same, but there probably will be less friction if the pay-as-you-go principle is adopted. Further, the issuance of bonds is decided too often on a purely political basis. Always there is left a dissatisfied minority. Financing from current revenue obviates delays due to getting bonds passed and does not periodically focus attention on costs rather than on services. Also, if rates and construction costs are carefully coordinated, funds are provided when needed, and bulges are avoided in fixed charges incident to floating bond issues. The great disadvantage is the temptation to divert water funds to other purposes.

Milwaukee, Racine and Kenosha, Wis., are examples of cities that finance their waterworks almost entirely from revenue. Milwaukee consumers enjoy one of the lowest rates in the country, and the department has practically no bonds outstanding. Racine for the last ten years has financed construction from current revenue. Thirteen years ago it purchased the system and has reduced the purchase indebtedness from $1,225,000 to $976,000. At the same time it has built from earnings a new intake, filter plant, elevated storage, pumping station and nearly 60 miles of mains at a cost of more than $1,900,000. Due to the under-built condition of the plant when acquired, this expenditure has represented $3 per capita per year, or double the usual or normal. Kenosha has essentially duplicated this record with $2.50 annual per-capita expenditures. Louisville, Ky., has spent several millions in the last few years financed wholly from revenue. In that city the water rate is high enough to provide for the most active construction period, and discounts varying from 10 to 33 per cent are applied depending upon the year's building program. The allowance of discounts for prompt payment of bills is far easier to arrange than an adjustment in rates.

Building a Low-Cost Base for a Low-Cost Road

A 3-in. tarred-stone base built on corn-belt soil, with a 2½-in. retread surface, for $9,000 a mile, including $1,400 for unneeded "depression-time" labor

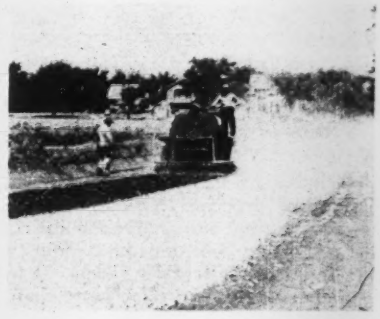
By John S. Crandell
Professor of Highway Engineering, University of Illinois, Urbana, Ill.

THE RETREAD or mixed-in-place type of road surface has been confined until recently to those locations where an old road existed of some kind better than earth. This, of course, has limited its usefulness, and it has been urged that some means be taken to make it available over any road. In the building of several miles of retread in Champaign County, Ill., some novelties have been introduced that should go far toward solving the problem.

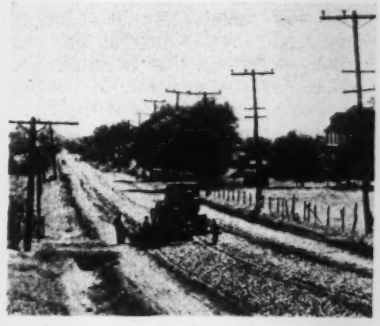
It must be kept in mind that the retread is a decidedly low-cost road, and that frills and fancies must be eliminated if costs are to kept down. In Champaign County some old oiled-earth roads were selected to be retreaded. They were of high crown, the oiled surface was down the center 10 ft., and deep ditches lined both sides. Although it would be desirable to keep the old surface intact, it was decided that it would not be possible to do so. The crown was removed with a blader, and the loosened oiled earth was strewn over the old roadway to form a new subgrade. This was rolled thoroughly so that there were no irregularities, depressions or bumps, which is easier said than done, especially if rain intervenes to displace the loose soil.

The scheme outlined was to build a 3-in. stone base on the old reshaped earth road, bind the base with tar and then place a 2½-in. retread top thereon. Because the base would be mixed in place, too, it was decided that the base stone could be kept clean only if the old road were given a prime coat of tar. This would keep the dust down and prevent the earth from mixing with the clean stone. So, as soon as the subgrade was shaped up, rolled and made reasonably smooth, it was given a treatment of tar at the rate of ½ gal. per square yard. The desired result was attained. The light tar penetrated sufficiently to hold the earth in place throughout subsequent operations. It is possible that some soils may require a little more prime coat, and to this end a trial here and there down the road might be given to see what the right amount should be. Probably ½ gal. need never be exceeded. The prime coat is absorbed rapidly, and there is no holding up of the work to permit it to set.

Over the primed subgrade was spread a 3-in. layer of 3-in. stone. In reality the stone sizes varied from that which would be held on a 2-in. ring to that which would pass a 4-in. ring, although there was little of the latter.



Loose-stone base 3 in. deep on tar-primed earth sprayed with ½ gal. of tar.



Tarred-stone, 3-in. base was given three bladings to mix the stone and tar thoroughly.

Bladed base course spread with ½-in. keystone rolled into the surface and finally treated with 3/10 gal. of tar.

The stone was spread with a maintainer. A very uniform layer was obtained, free from any admixture with the subgrade. It was then sprayed with ½ gal. of tar per square yard. The tar was one of 60 to 80 viscosity, Engler, and was heated before application. The stone was bladed three times. This insured a good coating with binder. In order to make the base tight and free from any tendency to move under traffic, it was keyed by the spreading of ½-in. stone over it and by rolling this stone into the voids. Further to assure the holding of the keystone, it was sprayed with 3/10 gal. per yard of hot tar and again rolled with a heavy roller.

The base was thrown open to traffic immediately and really was traffic-bound before the customary retread was built on it. It is the base which is the reason for this article. The writer was the first to build the retread type of road, and he believed that it was essential to have an old, solid road bed of gravel or macadam, or at least shale, before attempting to lay the top. Several attempts to lay a retread on old earth roads convinced him of the futility of such construction. To build a regulation gravel or macadam road as a base for the retread top would defeat the very purpose of the top—namely, low cost. The method of using a 3-in. bituminous-bound base offers a new solution.

If this thin base will stand up under the traffic that a secondary road customarily carries, then there are thousands of miles of county and township roads that may be retreaded at slight cost. In his original articles on the subject ten years ago the writer pointed out that one of the chief advantages of this type of work is that if the top begins to fail, it may be retreaded cheaply, and the road crust thereby thickened and improved. Subsequent retreading, of course, adds to the original thickness; and eventually, when traffic becomes really heavy, a road is in place ready to carry it, although little has been spent in the meantime.

In the present instance a regulation retread was laid on the well-bound and compacted 3-in. base. The top consists of 2½ in. of Kankakee limestone, from ¾ to 1½ in. in size, bladed into place and bound with two coats of tar. One coat was at the rate of ½ gal., after which the stone was well bladed, and this was followed with 3/10 gal., with a subsequent blading until every particle of stone was black. Chips, ⅜ in., were then spread, 10 lb. per square yard, and ¼ gal. of tar was sprayed on them to hold them in place during the rolling that followed. Another layer of chips was spread, tarred and rolled, and the road was thrown open to traffic without delay.

If the quantities be added, it will be seen that the total amount of binder, including the prime coat, is about 3 gal. a yard. Of this, slightly more than half is in the 3-in. base. No doubt this

seems to be a large quantity to be placed here, but observation while the work was in progress showed that no binder was being wasted, and that this amount at least was necessary to hold together so thin a base course on soil in the corn belt. It is possible that slightly less binder could be used in other parts of the country.

The cost of two roads close to Urbana, Ill., was about $9,000 per mile of 19-ft. road, complete with regrading, ditches and unneeded extra "depression-time" labor. Had it not been for the latter, the cost would have been about $7,600 per mile. Had there been any local stone, the cost would have been still less.

It will be of value to the roadbuilding fraternity to watch these roads during the coming winter and spring to see if they perform satisfactorily. If they do, then the 3-in. bituminous-bound base has a great future.

Imhoff-Tank Effluent Aerated To Reduce Load on Filters

Air is collected after having passed through the sewage and is used to ventilate the trickling filters, thereby avoiding odors

By W. R. Drury, Consulting Engineer
Hoad, Decker, Shoecraft and Drury, Ann Arbor, Mich.

A SECONDARY treatment plan, comprising a pre-aeration tank, ventilated trickling filters, final settling tanks and chlorination tanks, has recently been constructed to complete the sewage-treatment facilities at Flint, Mich. Four years ago the first units of the plant were built, consisting essentially of radial-flow Imhoff tanks and sludge-drying beds. The initial installation was described in *Engineering News-Record*, Sept. 6, 1928, p. 357.

The Imhoff tanks, designed for an average flow of 16 m.g.d., from an estimated population of 160,000, have given unusually good results over the four-year period of their operation. Meter records during the past four years indicate that the sewage flow has averaged only 85 gal. per capita. With this rate of flow the sedimentation compartments of the tanks have an actual capacity for 184,000 people. The average removal of suspended solids over the operating period has been 69 per cent and the removal of 5-day b.o.d. has been 50 per cent. While the tanks have not been loaded up to their full capacity, their design is such that practically the same removal of solids and organic material can be expected when they are called upon to operate at the rate for which they were designed.

As a result of these records of operation, it was decided to design the secondary treatment processes for a total population of 184,000 instead of 160,000, making a larger capacity plant and one in which the sedimentation and oxidation units were well balanced. Additional sludge digestion and storage capacity can be added in separate tanks when needed in the future.

To obtain reliable data on which to design the proposed trickling filters, a sewage testing station was built consisting of an aeration tank and two 10-ft.-diameter filters 7 ft. deep. It was operated over a period of more than a year. Sewage, after passing through the Imhoff tanks, was treated in this testing station under careful laboratory control. The operation of the testing station showed 15 to 30 minutes' aeration of the Imhoff tank effluent would reduce the 5-day b.o.d. by 15 to 20 per cent. Further, it showed that trickling filters could be operated at a rate of 400 lb. of 5-day b.o.d. per acre-foot if the Imhoff tank effluent were not aerated, and that the rate could be increased to 500 lb. per acre-foot if the Imhoff tank effluent were pre-aerated.

As a result of the experimental work the decision was reached to use pre-aeration ahead of the filters so as to reduce the size of the filters below what would otherwise be necessary. This resulted in a considerable saving in first cost. Another factor which was taken into account in arriving at this decision was the matter of odor control. Flint sewage is stale and septic when it arrives at the plant and some trouble from odors has been experienced.

The pre-aeration tank is housed over, and the air, after passing through the sewage, is collected in the tank building and discharged by a fan into the galleries through the trickling filters. These galleries are all closed up so that they are practically airtight against the very slight pressure that is caused by the ventilating fan. The air finds its way into the underdrain and up through the filter material. This device has the double advantage of disposing of noxious odors by having them adsorbed by the filters and of aerating the filters to some extent by means of forced ventilation.

The pre-aeration tank is 60 ft. long and 52 ft. 8 in. wide with a sewage depth of about 20 ft. Air is supplied by two blowers and discharged through ⅛-in. holes in copper pipe grids in the bottom of the tank. Sewage can be aerated for a period of half an hour at normal flow with air supplied at rates up to 0.12 cu.ft. per gallon. The tank has a brick superstructure with creosoted timber roof framing and composition roofing.

The trickling filters are in two units with a total effective area of 3.6 acres and a depth of 10 ft. They are designed for a rate of 4.45 m.g.d. per acre and a load of 500 lb. of 5-day b.o.d. per acre-foot. Automatic siphons and feeds with a twin dosing tank for each filter dose the filters through 8-in. cast-iron laterals fed from both ends and equipped with nozzles. Filter material is gravel and crushed boulders ranging from 1½-in. to 2½-in. size except within the bottom foot, which consists of hand-picked boulders 4 to 6 in. in size. The underdrains are concrete channels 6 in. wide and 6 in. deep, covered with hard-burned clay building bricks set 1 in. apart. The channels are 3 ft. on centers. Between the channels concrete ridges are built.

Final settling tanks, four in number, are each 100 ft. long, 14 ft. wide and average 12 ft. deep. They are equipped with drag-scraper-type sludge-removal mechanisms. Sludge is discharged to a sludge well from which it is pumped to the incoming sewage as it goes to the Imhoff tanks. Chlorination is effected through the use of liquid chlorine handled in 2,000-lb. drums and fed by dry-feed machines into the filtered and settled sewage. A chlorine reaction tank, 55 ft. long, 23 ft. 4 in. wide and 11 ft. deep, gives sufficient period of reaction. The treated sewage is discharged over a white-tile display weir and from thence through a submerged multiple outlet into the Flint River.

The plant was designed by Hoad, Decker, Shoecraft and Drury, consulting engineers of Ann Arbor, Mich., and constructed by the W. E. Wood Co., of Flint and Detroit, Mich. The work was under the immediate charge of T. A. Hammond of the city engineering department.

New Zealand Railway Opening

The Stratford-Main Trunk Railway (New Zealand) is expected to be in operation sometime this month when the last section, 89 miles in length, is completed. The new line provides a direct link between the Taranaki district and Auckland and will result in a great saving of time. Under the old system the distance from Auckland to New Plymouth was 444 miles, which is reduced to 286 miles in the new route. Fares and freight rates between Taranaki and Auckland will be reduced heavily by the new line.

Letters to the Editor

Parabolic Vertical Curves

The writer read with interest Professor Furr's article in *Engineering News-Record*, Oct. 27, 1932, on parabolic vertical curves for highway grades, and the following is merely by way of friendly criticism.

A vertical curve serves two purposes: first, to improve vision over a hill, and second, to connect up intersecting grades so that we may pass from one to the other without a jolt. Years ago, when the writer was in railroad work, we were given to understand that there were two things we should never forget; one was that no railroad location was feasible in which a reverse curve had less than 300 ft. of tangent between the two curves. That applied to alignment.

The next fundamental was never to establish a grade line less than 1,000 ft. long, or, in other words, breaks in the grade must not occur at less than 1,000-ft. intervals. Where sharp grades intersected, we would use vertical curves up to 1,000 ft. long, in exceptional cases. Usually we made them 500 ft. long, and on gentle curves or grades we made them 300 ft. long. With these simple expedients, we never had trains break in two in passing over the intersections of convex grades.

In passing over a great many thousands of miles of improved highways, the writer has wondered frequently why it was necessary to break grades as often as 300 ft. or 400 ft. Only yesterday, he passed over a federal highway, in which there were three vertical curves in less than 1,100 ft. It is probable that the man who laid those grades was attempting to balance cuts and fills too theoretically.

The writer will venture to say that if the whole thing had been flattened out to a level grade, it would not have increased the yardage to exceed 200 yd., and at the present price of dirt-moving it seems absurd to break these grades so often and require so many vertical curves, which give a highway the appearance of a roller coaster grade instead of a high-speed highway. In fact, the writer believes that if more attention were to be given to establishing longer grade lines, the question of visibility over intersecting convex grades would be greatly lessened and the cost of construction would not be appreciably increased.

Again, the writer has observed many places, where in order to balance cuts and fills, light cuts averaging 3 to 4 ft. have been made in comparatively level prairie, from ¼ to ½ a mile long, and the cost of keeping that piece of road clear of snow in the winter time has undoubtedly cost more than it did to grade the road itself.

It is interesting, of course, to know the proper formulas for figuring visibility and parabolic vertical curves with unequal tangents, but the writer contends that with proper laying of grade lines, the number of parabolic curves could be reduced materially at practically no increase in cost of construction or maintenance. It certainly was true in railroad construction, and it should be true on highway construction.

Beardstown, Ill., Nov. 2, 1932. A. D. MILLARD.

The Meadows Viaduct

Sir—I have just noticed the reference in your issue of Dec. 1 to the opening to traffic of the high-level viaduct on New Jersey Route 25 across the meadows between Jersey City and Newark, and I believe that an erroneous impression may be created by the manner of your reference to those who have been connected with the inception and carrying out of this very important contribution to highway construction and progress.

The reference to Col. H. W. Hudson, after all the other names, merely as "engineer in charge of construction" does not credit him with the very important part he has played in the inception, design and successful completion of this work. The inadequacy of some engineering titles in conveying properly the importance or otherwise of the work done by the holder thereof is, of course, well known, and I feel that in the interest of accuracy the following should be said:

The actual design of the structure itself—that is, the determination of strains and stresses and the proper proportioning and arrangement of the parts—has been ably carried out by and under the direction of Sigvald Johannesson; but for the general conception of the project credit should be given to Colonel Hudson. The ability to persuade the municipalities, the counties, the state and the highway commission that the project was sound, the general direction of the surveys, the general supervision of the design, the preparation of contracts and specifications, and the final general supervision of the construction and the successful completion of the whole project should all be credited to Colonel Hudson.

I think also the fact should not be lost sight of that this whole project of a bypass highway to relieve the congestion of Jersey City, Newark and Elizabeth was conceived by Major William G. Sloan, for several years state highway engineer of New Jersey, who had the foresight to see the effect of the traffic of the Holland Tunnel on an already difficult situation, and the nerve to suggest and the ability to sell to the highway commission the adequate plans for this work, which have now, after ten years, been brought to a most successful conclusion. FRED LAVIS,

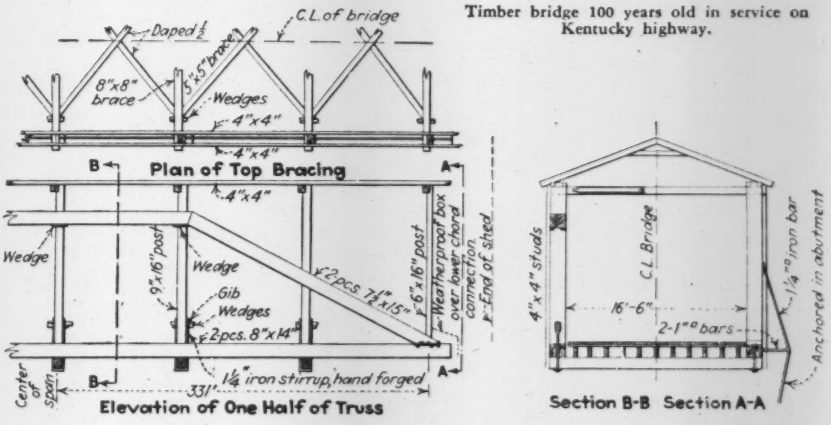
New York, N. Y., Dec. 12, 1932. Consulting Engineer.

MR. LAVIS was in charge of the planning and design of the Meadows Viaduct from 1924 to 1928, when Major William G. Sloan was state highway engineer. In that period a viaduct project with 35-ft. clearance height was conceived, worked out and officially adopted. Because of special demands arising with respect to location and height of the river crossings this project later was developed into the final project with 135-ft. clearance height, which was done under the direction of Colonel Hudson, with Jacob L. Bauer, state highway engineer. —EDITOR.

Old Timber Bridges

Sir — The accompanying drawing shows the construction of an old wood-truss highway bridge built about 1831, which was in use in 1931 and evidently has a life of many years to come if as well cared for as it has been in the past. The bridge, with truss members of poplar, is of the covered type, and the siding is of long-leaf yellow pine, as are the rafters and studs of the housing. It was evidently roofed originally with shingles, which have been replaced by galvanized-iron sheets.

Attention is called to the special housing built over the end lower con-



Timber bridge 100 years old in service on Kentucky highway.

nection of chord timbers and the batter posts, also the plate at the base of the batter posts. This housing is well within the main housing of the bridge by some 6 or 7 ft. in the clear, and its function is to prevent dirt, trash and road droppings from being lodged on and in the joint and by accumulating moisture that might start decay. As the original timbers are still sound, it has served its purpose perfectly. Thorough ventilation of all truss members is assured, as they are so constructed that the various sticks touch only at the joints.

This bridge and two more of the same type are on the old turnpike road which runs between Winchester and Paris, Ky.

At Paris there is a much larger wood bridge still in use on the main highway after 100 years of service. This bridge is, I think, about 160 ft. long and has three wood arches clamped by trusses, giving two lanes of travel. At some time, long after the bridge was put in service, a footway was hung on one side outside of the housing. This bridge has had some renewal of timbers, as it was not so well protected from decay as the three smaller bridges, but when I visited it the bridge was being crossed at short intervals by all kinds of trucks, including the ones from a big state-owned crusher plant near the bridge.

Kansas City, Mo. CHARLES KYES ALLEN.

Bituminized-Cement Concrete

Sir—The articles on bituminized-cement-macadam roads in *Engineering News-Record*, Oct. 6 and 20, 1932, pp. 400 and 463, raise some interesting speculations.

The reported freedom from cracks of the German roads calls for an explanation which it is to be hoped will be found in the character of the new cement. If concrete made of the new cement is even approximately free from shrinkage and temperature cracks, this cement might well revolutionize concrete engineering.

However, there is no reference in the published articles to the performance of this cement in ordinary concrete, and unless or until the crack-free quality is demonstrated for premixed concrete, the question can well be raised as to whether the cement or the method of use accounts for this quality.

It has been pretty well established that shrinkage results largely from loss of water, and to a lesser extent from temperature reduction. Premixed concrete for workability requires an excess of water, cement and mortar between adjacent stones. This permits shrinkage of the entire slab from loss of moisture in setting. When the rock is spread and rolled without mortar, adjacent stones are in intimate contact, wedged together with some initial pressure. After grouting, the shrinkage from loss of water is therefore limited to each individual isolated body of mortar, filling each void without shrinking the entire slab except to the extent that the stones themselves would shrink on loss of water. This is negligible in the case of trap rock as at Hampden, and practically so in case of any rock suitable for good concrete.

Even if moisture shrinkage of the slab is eliminated by method of construction instead of by the type of cement, there is still required a reason for absence of cracks from reduced temperature. Perhaps this amount of shrinkage alone can be resisted by the strength of the concrete in tension, or perhaps the new cement gives to the concrete a very low modulus of elasticity, permitting it to resist the shrinkage without stress enough to cause cracking.

I probably speak for many engineers when I say that I am anxiously awaiting data as to modulus of elasticity and other physical properties of the new concrete when premixed for general use rather than when mixed by methods applicable only to road work.

Chicago, Ill., Oct. 31, 1932. L. F. HARZA, Harza Engineering Co.

Average Bid Advocated

Sir—We have all seen disaster come to the contractor who has decided to get a job regardless of profit or loss. Not only has the contractor suffered the consequences, but in many instances the owner has been put to extra expense as well as compelled to accept a very poor class of workmanship, a condition which he would gladly rectify with an additional cost of 10 or 15 per cent, were it possible.

The average bid would seem a solution to this difficulty at least in municipal, state and federal contract practice. The average bid, as I see it, would range from 15 per cent below the engineer's estimate to 10 per cent above the engineer's estimate. This gives the contractor's engineers and the project engineers a 25 per cent variation in opinion, which is liberal considering that competent engineers are involved in each case. All will agree that only competent engineers should be employed on either side. Let us take an example:

Engineer's estimate, labor and material—$100,000.

Bids 10 per cent above the estimate thrown out.

Bids 15 per cent below the estimate thrown out.

Engineer's estimate does not have to be made public.

Five bidders, *A*, *B*, *C*, *D* and *E*.

A	$111,000
B	99,000
C	89,000
D	104,000
E	84,000

A and *E* bids thrown out; the average of *B*, *C* and *D* bids is $97,333.33. Therefore *B* gets the contract for $99,000, this being the nearest to the average bid of $97,333.33.

This assures the contractor that good work can be done at a reasonable profit under average foreseen conditions; it assures the owner that the letting of the contract to the average bid should result in good work, a reasonable profit and a general feeling of security.

In this day and age there is no sane reason for engineers to continue to be spectators in the throat-cutting contests that are being held daily by the contractors at public lettings, and then having grave doubts about the outcome of the construction project.

Denver, Colo., Nov. 1, 1932. CARL A. GOULD, Construction Engineer.

Bid Peddling

Sir—This letter is to compliment you on the editorial on bid peddling entitled "Remedy At Hand" in your issue of Oct. 6, 1932, p. 414.

We in Detroit have become more and more convinced that the only solution for bid peddling is the one-price system which you mention, but we wish to point out forcibly that it must be a one-price system for everyone concerned.

There have been far too many charges that the general contractor is the bid peddler in spite of the fact that an overwhelming majority of the jobs let in the last few years have proved that bid shopping starts with the owner and ends with the last material man who furnishes a subcontractor of a subcontractor of a subcontractor. There have been but few jobs let in this vicinity in the last two or three years that have not been shopped, or suffered a second bidding, a third bidding and in some specific instances as high as a fifth or sixth bidding before the general contract was let.

It has reached the stage where the federal government, the largest owner that is building today, and to whom nearly everybody looks for precedent, seems to have accepted and adopted the policy. Within the last week, on a federal post office job within two or three hours' run of Detroit, second bids were taken on minor changes in the bond of the exterior material, and all bidders were invited to rebid. Will that help to hasten prosperity's return?

The example, set by the federal government, if persisted in, precludes any one-price system, and whether or not architects or general contractors or subcontractors or material suppliers like it, bid peddling will stay with all of them until it can be cured.

We have no thought that it is the intention of the federal government to throw this industry or any other into chaos, but we lay it rather to listening to too many people who have an axe to grind on a specific job.

In every way possible the fact should

be brought home to the federal government and to everyone interested as a buyer or producer of construction that award on the first bidding will do more to help the industry to straighten out its troubles than anything else they could do.

We hope that you, through your editorial columns, will eternally carry on the fight to convince everyone from the owner down to the last material supplier that a one-price system from top to bottom, which means a first-bid system, is the only fair and safe way, and in the last analysis the only economical way, for everyone concerned.

RALPH A. MACMULLAN,
Secretary, General Builders Association of Detroit.

Detroit, Mich.
Oct. 21, 1932.

Agency Service in Job-Hunting

Sir—When thousands of engineers are out of employment, no doubt many have read the advertisements of employment agencies and employment counselors and wondered if they could secure a position through such sources. The experiences and impressions of one man with agencies and letter campaigns may be of interest.

Reliable people engaged in special letter campaigns seem to agree that such campaigns are practically hopeless under present conditions for the man without more than ordinary accomplishments, whose earnings have not exceeded $3,600 per year, or who is past the age of fifty.

Employment campaigns are of two kinds. One is a straight letter campaign, in which the agency undertakes to study your record and send out a definite number of letters, usually 500 or more, to executive officers in a selected list of firms to be OK'ed by the subscriber, for which the subscriber pays in advance an agreed amount. Some agencies turn the letters over to the subscriber to be mailed by him. If a position is secured, the usual placement fee is charged. In some cases the cost of the campaign is deductible from the fee, while in others it is not. If the campaign is not successful, the subscriber is out his special service charge.

The other kind is explained somewhat as follows: "We do not operate on the letter-writing basis alone but make selected lists from our files of employers whom we have served and communicate with them. Some we write, some we telephone, others we may telegraph. Our service is not limited to letter writing but is an unlimited service, good until we have placed you. When you are successfully placed you pay the regular fee, minus the cost of the special service." Until you are placed the agency is "working on your case;" but check them up if you can! The agency's lists may be made up from a purchasing agent's register or sorted out from the files in short order.

One of these agencies told the writer that its placements were 71 per cent of the special campaigns it undertook this year, while last year the figure was 64 per cent. These figures are four to six times those of other agencies. Another agency stated that it undertook only about one special campaign per day, that it had about 100 cases in its file, and that its placements in six weeks were about equal to the number of cases in the file; this office was later closed by the police.

A person contemplating a special service campaign may save himself some money and disappointment: (1) by avoiding dealing with any concern that professes to be ignorant of its percentage of placements to campaigns; (2) by regarding with suspicion any high figures unsupported by good evidence of their truthfulness; (3) by avoiding any scheme that cannot be checked in its operation; and (4) by not expecting too much, remembering that engineers are among the least wanted of all at the present time.

After looking into the matter carefully and having certain records thrown open for his inspection, the writer would regard with suspicion any percentage of placements for engineers, salesmen or accountants higher than 25 per cent; 15 per cent will cover the majority of agencies, with many running even less this year. If good care is not exercised in selecting the cases undertaken and if the letters are not skilfully written, the results will be considerably lower.

The thing an agency can do for the client is to write a dignified sales letter to a number of firms without broadcasting the client's name as a job-seeker. It will probably write a better letter than the client could write for himself. The agency knows the employment trend in different lines of work and is in a position to advise whether it has a fair chance of placing the client or not. But unless the cost of the proposed campaign is borne partly by the agency, its advice may be worse than none.

The cost of 500 letters or more should not exceed 10c. per letter for multigraphed work on good stationery, or 15c. for automatically typed letters, and it may run to less. These costs cover the making of the lists, stationery, postage, multigraphing or typing, filling in of addresses on letters, addressing envelopes, folding and sealing, the agency sharing the expense to the extent of its overhead.

CONSTRUCTION ENGINEER.

New York City,
Nov. 4, 1932.

Overbreak in Tunnel Excavation

Sir—C. E. Blee, in his paper, "Driving Bridge River Tunnel, British Columbia," (*ENR*, Aug. 11, 1932, p. 169), brings out interesting features in tunneling. In his discussion of payments for overbreak, Mr. Blee states that the volume of overbreak in the tunnel was greatly minimized by introducing a special provision in the contract, that the concrete used in filling the volume of overbreak will be paid for at a fixed price of $8 per cubic yard, or $2 less than the estimated actual cost of the concrete in place. A similar provision was made in construction of the tunnel at Asheville, N. C., in which the yardage of concrete poured beyond the neat line of the lining in rock section was paid for at three-fourths the price of the ring concrete (*ENR*, March 15, 1928, p. 441).

The overbreak is undesirable not only because additional concrete is required to fill its volume, but also because uneven overbreak usually weakens the ground and facilitates penetration of moisture to the lining.

A most rigid provision for overbreak was made for construction of the highway tunnel at Richmond, Calif., built in 1912, in which no allowance was made for excavation beyond the neat line indicating the concrete lining, or for concrete used in filling the volume of overbreak.

A. A. EREMIN,
Assistant Bridge Design Engineer, State Highway Commission.

Sacramento, Calif.,
Oct. 24, 1932.

Wrong Organization Quoted

Sir—On the editorial page of *Engineering News-Record*, Nov. 24, we find an editorial entitled "Self-Supporting Waterways." In this editorial the Chamber of Commerce of Kansas City is alleged to have disbanded its waterways committee, etc.

For your information this action was taken by the Board of Trade in Kansas City, which is the grain exchange, and was not taken by the Chamber of Commerce. The position of the Chamber of Commerce was that the government should continue its work on the river until it has demonstrated whether or not barge transportation on the Missouri River is practicable. As soon as this is demonstrated, our recommendation is that the barge line then be turned over to private operation. We feel, however, that inasmuch as the government has gone this far it should continue the work until the navigability of the river is proven. Otherwise it would be impossible for private enterprise to take it on under present conditions. We are assuming from the government's report that this demonstration will be made within a very short time.

We agree with the Board of Trade, however, that eventually waterways navigation should be turned over to private enterprise and stand on its own feet, but not until the work that the government set out to do is completed.

W. M. SYMON,
Executive Manager, The Chamber of Commerce of Kansas City.

Kansas City, Mo.,
Nov. 29, 1932.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

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More Than a Century

When one hears that a technical publishing house has passed its 125th birthday, he becomes conscious of the fact that America has not only come of age but has attained respectable maturity. John Wiley & Sons celebrated this happy anniversary a few days ago. No less interesting than the anniversary itself is the unbroken continuity of family ownership and management of the house, four successive generations having guided the firm's destinies. The name Wiley may be said to figure in the history of engineering development in America, since technical books share the mission of the college, the engineering society and the technical journal. With its background of influence, tradition, and continuity of name and achievement, the house has the best wishes of all readers of technical books for further long life and usefulness.

Vibration Control

VIBRATION PREVENTION IN ENGINEERING—By Arthur L. Kimball, Research Laboratory, General Electric Co. Cloth; 6x9 in.; pp. 145; line drawings. Published by John Wiley & Sons, Inc. New York City, and Chapman & Hall, Ltd. London. $2.50.

Although directed principally toward the subject of machine vibrations and methods of preventing or damping them, this book contains enough discussion of the fundamentals of vibratory motion to be of somewhat general interest. Machine foundations or supports, building floors and movable bridge spans that must carry machinery are examples of structural elements whose design can benefit from a knowledge of vibrational energy and its control. The author, who has had extensive experience in vibration work, states in the preface his belief that the book contains all the material necessary for handling any usual vibration problems.

* * *

To the Engineering Aspirant

ENGINEERING: A Career: A Culture—By the Education Research Committee, The Engineering Foundation. Paper, 6x9 in.; pp. 61; illustrated. Published by The Engineering Foundation, 29 W. 39th St., New York, N. Y. Price, single copies 15c., less in quantities over 50.

Engineers will find the brief time well spent that is required to read this "message to young men, to parents and teachers." It is written primarily to tell the adolescent youth something of what engineering is and of the mental and physical characteristics that a man must have if he is to succeed as an engineer. Its secondary purpose is to help parents and teachers in advising boys in the selection of a career by setting up a scale of mental and physical equipment and of schooling against which to measure the boys. The practicing engineer will find in the pamphlet a refreshing summarization of many and varied functions of his profession and new inspiration to attain the ideals that the profession has set for itself. The pamphlet should be placed in the hands of every boy who has any idea of taking up engineering in later life as a profession.

* * *

Historical Notes on Pumps

PUMPING MACHINERY. Part I—Historical Notes—By G. F. Westcott. Paper; 6x9 in.; pp. 103; photographs and line drawings. Published by H. M. Stationery Office, London. 2s. 6d. net.

Many interesting facts relating to pumps are assembled in an easily readable form in these historical notes on pumping machinery. The record begins with the most primitive forms of pumps of which we have any record, and it is brought down to the present day. Illustrations are used freely. A chart at the end of the book illustrating the development of pumping machinery sums up the record in a concise and thoroughly understandable manner.

* * *

Civil Engineering in Terms of Its Pioneers

EARLY YEARS OF MODERN CIVIL ENGINEERING—By Richard Shelton Kirby and Philip Gustave Laurson. Cloth; 6x9 in.; pp. 324; photographic illustrations. Published by Yale University Press, New Haven, Conn. $4.

The period in history when ancient construction habits began to assume some of the characteristics of present-day scientific practice is set early in the eighteenth century by this book, which is what might be termed a "biographical" history of civil engineering. Its story is told in terms of the pioneers themselves, and only incidentally in terms of pioneer structures. In attempting to cover the whole field of modern civil engineering the authors have had to write sketchily, but the broad general picture is successfully painted. Footnotes and bibliographies, almost as voluminous as the text itself, provide a key for readers who would dig deeper into the history of any particular division of the field. An interesting characteristic of the book is a free use of quotations from writings of many of the pioneers. The reproductions of old maps and photographs, which are extensively used, reveal many interesting structures, some of which were built and others of which were merely air castles. A chapter of biographical outlines, made up of short paragraphs on 115 early civil engineers, should prove particularly valuable for reference. Civil engineering, for purposes of this book, includes surveying, canals, highways, railroads, bridges, tunnels and subways, waterworks and water power, sewers, and river and harbor work.

Zoning with Reason

Reviewed by Robert Kingery

URBAN LAND USES—By Harland Bartholomew. Cloth; 7x9½ in.; pp. 174; many tables, drawings and halftones. Published by Harvard University Press. $3.50.

EVERY real estate man, whether he call himself subdivider, broker, developer or any other name, should be compelled to read, memorize and follow substantially the precepts expounded in Mr. Bartholomew's excellent volume. So also should every member of a plan commission, zoning commission, board of appeals, city council, village or town board. It will be exceedingly valuable of course to students.

For the first time, in this volume, there have been assembled in one place certain quantitative facts in regard to the use of land in cities. Even our ablest city planners, until very recently, were exceedingly hazy about the amount of business area to provide for a given community, about the area to set aside for industry and about the residential area that is occupied by a given population. When the theory was first advanced that there is a definite relationship between a population and the amount of land used by it for industry, business residence and parks, both the layman and experts expressed skepticism. They proclaimed that it was not so simple a matter of arithmetic.

However, since the enforced removal of rose-colored glasses from the eyes of the average citizen, zoning authority, real estate promoter and speculator, all have been astounded at the present over-zoning for industry and business and the lack of balance between zones; and especially has everyone been shocked to realize how greatly over-subdivided is the land surrounding most of our cities large and small throughout the country. When it is realized that without violating the zoning ordinance of the City of Chicago the entire population of the United States may be housed within the present limits, we begin to grasp just what has been done in many other communities.

In checking Mr. Bartholomew's findings in regard to land areas used by

a given population, the staff of the Chicago Regional Planning Association compared his findings with figures for the Chicago metropolitan area. It was surprising to discover that in the 22 cities contained in Mr. Bartholomew's study the number of acres in the listed land uses for each 1,000 persons was 81.7, while comparable figures for the region of Chicago are 83.3.

Some city planners would not agree with Mr. Bartholomew's statement, on p. 152, that a total survey of land used in any city will closely approximate many of the findings on his research. We find no objection to that statement.

Some of his conclusions on satellite cities do not correspond with the findings in Chicago suburbs. In attempting to learn the reasons we found that his six satellite cities were not all comparable to those surrounding Chicago. River Forest, Ill., a suburb of Chicago included in his table, is one of unusually high type and not wholly typical.

The tables containing a summation of his findings are most useful. Since Mr. Bartholomew always discusses them in order of population, it would have been more convenient for the reader had they been arranged in that manner. Apparently his arrangemenet was in accord with the date of survey, which means nothing because they were all surveyed in or since 1928.

Housing Research

HOUSING OBJECTIVES AND PROGRAMS—Cloth; 6x9 in.; pp. 345. Published by the President's Conference on Home Building and Home Ownership, New Commerce Building, Washington, D.C. $1.15 postpaid (foreign $1.25).

FARM AND VILLAGE HOUSING—Cloth; 6x9 in.; pp. 293; halftones, line cuts and tables. Published by The President's Conference on Home Building and Home Ownership, New Commerce Building, Washington, D. C. $1.15 (foreign $1.25), postage prepaid.

HOME OWNERSHIP, INCOME AND TYPES OF DWELLINGS—Cloth; 6x9 in.; pp. 230. Published by the President's Conference on Home Building and Home Ownership, New Commerce Building, Washington, D. C.; $1.15 postpaid (foreign $1.25).

THE three volumes noted above conclude a series of eleven volumes compiled by committees of the President's Conference on Home Building and Home Ownership. Of the volumes published previously those of interest to the civil engineering field have been noted in these pages (May 19, p. 736; Aug. 18, p. 203; Oct. 20, p. 476). Vol. XI, "Housing Objectives and Programs," is a summary of the work of the conference and an outline of research yet to be done in the study of the nation's housing problems, but the student of housing will find that parts of Vol. IV, "Home Ownership, Income and Types of Dwellings," can well be studied with it in order to get a broader view of the housing situation.

The need for research in the study of our housing problems is the outstanding impression growing out of a review of these two volumes. Robert P. Lamont, in his forewords to the two volumes makes the following pertinent comment: "The market for good housing within the reach of the poor man's pocketbook is the richest untapped market in the world. It would be a gratuitous reflection on modern science and engineering to suggest that the production of such housing is impossible. Until the last few years it has never been tried. . . . The section on technological developments (Vol. IX) indicates that practice in house construction lags well behind knowledge."

Study of how house-construction practice can make full use of technological developments and of how financing and construction of both the individual home and community housing can be improved by law are problems that the conference passes on to the future for fuller study based upon the data it has assembled.

Miscellaneous Notes on Booklets and Reprints

GROUNDWATER SUPPLIES of the Passaic River Valley near Chatham, N. J., and of the Camden area are reported on in Bulletins 38 and 39 of the New Jersey Department of Conservation and Development, Trenton, N. J.

LITTLE KNOWN ENGINEERING WORK being carried out under the direction of American and Chinese engineers is summarized in the 1931 annual report of the China International Famine Relief, Peiping, China. The commission is carrying on extensive irrigation, flood protection and road work—"feeding with a spade rather than a spoon"—in order to get the maximum benefit from its funds.

CARBON MONOXIDE IN THE LIBERTY TUNNELS at Pittsburgh, Pa., is the subject of a reprint from the *Journal of Industrial Hygiene* for October. The paper reports progress on a study authorized by the board of commissioners of Allegheny County. Results to date show a 5-min. peak of traffic of 284 cars, or at the rate of 3,400 per hour. Carbon monoxide concentrations at times exceed the desired maximum concentration.

COST OF PUMPING FOR DRAINAGE is the title of a 100-pp. bulletin (No. 32, 10c.) of the U. S. Department of Agriculture, giving costs on seventeen typical drainage districts in the Upper Mississippi Valley. The study was begun in 1925 and had for its purpose a consideration of the economy actually obtained with different types of power, electric, oil-engine and steam. Numerous comprehensive tests were made to determine efficiencies of the pumps and the over-all efficiencies. Costs include yearly operating expenses and fixed charges of interest and depreciation. A warning is given that great care must be exercised in applying the data because so many factors affect the cost of pumping. A frank statement of experience with electric and diesel power is given.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

AMERICAN CIVIC ANNUAL—Edited by Harlean James, executive secretary, American Civic Association. Cloth; 5x8 in.; pp. 276; many photographic illustrations. Published by American Civic Association, Inc., Union Trust Bldg., Washington, D. C.

CHEMIE DER ZEMENTE—By Dr. Karl E. Dorsch. Paper; 7x10 in.; pp. 277; tables and line drawings. Published by Julius Springer, Berlin. 23.50 RM.

CONTINUOUS FRAMES OF REINFORCED CONCRETE—By Hardy Cross and Newlin Dolbey Morgan. Cloth; 6x9 in.; pp. 343. Published by John Wiley & Sons, Inc., New York, and Chapman & Hall, Ltd., London. $4.50.

ORGANIZATIONS IN THE FIELD OF PUBLIC ADMINISTRATIONS. A Directory—Paper; 6x9 in.; pp. 203. Published by Public Administration Clearing House, 850 East 58th St. Chicago, Ill. Price $1.

THE PORTS OF PHILADELPHIA, PA., CAMDEN AND GLOUCESTER, N. J., and PORTS ON THE DELAWARE RIVER ABOVE PHILADELPHIA—Port Series No. 4, Part 1; revised 1932. Prepared by The Board of Engineers for Rivers and Harbors, War Department in cooperation with the Bureau of Operations, United States Shipping Board. Paper; 6x9 in.; pp. 360; maps; tables and photographic illustrations. Published by the Superintendent of Documents, Washington, D. C. $1.00.

PROBLEMS IN HUMAN ENGINEERING—By F. Alexander Magoun, Associate Professor of Humanics, Massachusetts Institute of Technology, and his students. Cloth; 5x8 in.; pp. 535. Published by The Macmillan Co., New York, N. Y. $2.60.

PUBLIC AND PRIVATE OPERATION OF RAILWAYS IN BRAZIL—By Julian Smith Duncan. Cloth; 6x9 in.; pp. 243; maps and table. Published by Columbia University Press, New York, N. Y. $3.75.

RESORSE IDRAULICHE PER FORZA MOTRICE—Servizio Idrografico, Ministero Dei Lavori Pubblici. Vol. I, Regione Lombarda; Vol. II, Regione Piemontese. Paper; 7x10; pp. 343; numerous maps and illustrations. Published by Provveditorato Generale Dello Stato Rome. Price, 45 lira per volume.

SANITATION OF WATER SUPPLIES—By Murray P. Horwood. Cloth; 6x9 in.; pp. 181; photographs, tables and line drawings. Published by Charles C. Thomas, Springfield, Ill. and Baltimore, Md., $3.

STRUCTUAL MECHANICS—By Harrison W. Hayward, Addison F. Holmes and Ralph G. Adams. Cloth; 6x9 in.; pp. 182; line drawings. Published by McGraw-Hill Book Co., Inc. New York and London. $2.25.

VALUATION OF REAL ESTATE—By Frederick M. Babcock. First Edition. Cloth; 6x9 in.; pp. 593; line drawings and tables. Published by McGraw-Hill Book Co., Inc., New York and London; $5.

Engineering News-Record

EDITOR—F. E. Schmitt. EDITORIAL STAFF—V. T. Boughton, W. G. Bowman, F. W. Herring, C. S. Hill, H. W. Richardson, W. W. De Berard, N. A. Bowers, J. I. Ballard.

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DECEMBER 22, 1932 Volume 109 Number 25

Christmas, 1932

IN THIS SEASON of yearly renewal of the spirit of human friendliness and brotherhood the engineer finds special occasion for translating this spirit into practical deeds. The thousands of engineers who are in distress from many months of unemployment need help, and will continue to need it throughout the winter. Their more fortunate colleagues have already responded to this need by organizing effectively for joint relief. Yet the need is not fully met. May Christmas therefore revive and strengthen the practical spirit of professional brotherhood and bring even greater support to the relief movement, so that no member of the profession shall remain in distress.

Work and Transit

RESUMPTION of work on the uncompleted contracts for extensions to New York's new subway system and the provision of money for new contracts have a double significance. They help the unemployment situation by providing more constructive work, and helps the new transit system and thereby the city government by making possible the early opening of the lines into Brooklyn and the Bronx. Little remains to be done to make parts of the Brooklyn line and the Bronx line ready for operation, and early in the new year they should be feeding traffic to the Manhattan line. Further extensions of the Brooklyn line and opening of the Queensborough line can be brought about at a relatively small cost. Nothing now should be permitted to delay realization of a return upon the investment already made, especially as it will provide work when constructive work is badly needed.

A Buried News Item

A TRANSPORTATION news item of more than usual interest is found buried in a quarterly departmental report of the railroad transportation division of the Public Service Commission to Charles A. Halbert, state chief engineer of Wisconsin. It is as follows: "An extensive field survey and investigation was made of transportation facilities between Sheboygan and Fond du Lac. The various services involved at present are a steam railroad, an electric railway and a motor-coach line. The petitioners desire to combine these facilities so as to give more adequate service and to avoid duplication of service. This is about the first case of its kind to come before the commission." When such petitions become common, the transportation problems of the country will be less serious, the public will be more tolerant, and transportation will operate more economically. Coordination of duplicate services is an essential need of the present confused and uneconomic transport situation. The item should have had place in the pages of every newspaper as information bearing vitally on the public interest, instead of being left hidden in the pages of a little-read public document.

Planners Both

IN A MOST opportune gathering last week the New York Architectural League held out the hand of fellowship to the civil engineering profession. Architect and engineer recognized one another as brother craftsmen. The occasion was a unique expression of professional harmony, and its theme invites thoughtful reflection. The civil engineer in particular will do well to note that his group does not stand alone but is part of a larger professional community, whose cooperation can bring more good to the world than any single group can achieve. Planners both, architect and engineer have a joint responsibility in scheming out the world's construction, for their labors determine a large part of man's physical environment. The modern city is their greatest work, and if this is to become more successful as measured in human satisfaction and in lasting worth it will become so only through their better planning. So there is powerful reason for the two professions to cooperate. Since engineer and architect also are subject to the same controlling forces, and since both depend on the will of men to progress and to build, it is clear that they have a close bond of common interest. Nor are they alone in this respect, for they share this common interest with the entire circle of workers in construction; the closer cooperation of that circle will be aided by full recognition of the close fellowship of architect and engineer.

Buy at Home?

IN VIEW OF the widespread sentiment that all buying should be done in the home locality, a statement by the Illinois Manufacturers Association is timely. The Association condemns a new "Buy Illinois Products" movement, asserting that the movement will do the state more harm than good, and cites facts on the industrial position of the state in support. Were the home buying movement to become established in Illinois and were other states to resort to corresponding practice in defense, industries employing half a million workmen would be affected in diastrous degree, and hundreds of millions in wages would be involved. And like conditions affect every state; all depend vitally on freedom from trade barriers. In these times, therefore, when the demands of local employment and trade are exceptionally weighty, contractors and awarding officials have a heavy responsibility. They must take care of local needs as far as compatible with efficiency and economy, and at the same time keep in mind the fundamental principle of unrestricted trade as the overshadowing consideration.

Progress Note

IN THE early stages of development of an art every small happening is significant. Thus, the use of reinforced brickwork for a diversion and regulator chamber on the Dearborn, Mich., sewer system, although involving only about 60 cu.yd. of masonry, denotes progress. One more type of structure is added to a list that has been growing steadily over the past three years. There remains extensive need for more design research

in reinforced brickwork, but until results of such work are available it is quite proper and safe to use the recognized principles of reinforced-concrete design. This a number of engineers are doing, and are thereby providing the profession with valuable field experience. On the Dearborn work a bricklayer-hour plus two helper-hours accounted for 10 cu.ft. of reinforced brick masonry in place. This is useful information. The action of the beams and slabs that carry an earth load of more than 2,000 lb. per sq.ft. will also be worth recording. Since field experiences are often more valuable than laboratory tests, engineers who elect to use reinforced brickwork are in the position of investigators, and the data that they can obtain will have useful bearing on future practice.

Municipal Finances

ON ANOTHER page in this issue appears the closing article of the series that has been running during the current year dealing with the condition of American cities in the light of their alleged extravagance and mismanagement. In a sense the entire series led up to the question discussed in the present article: What is the condition of municipal finance?

As far as the construction of community facilities is concerned there can be no question that the problem of municipal credit is the most vital phase of the entire municipal-economy issue. It is hardly likely that cities will lay up cash reserves in brisk times to permit a normal program of capital construction during days of adversity, and hence the ability to borrow funds on reasonable terms even during depression years is an essential element of any orderly program of planned improvements. Obviously, the appraisal of municipal credit is a matter of such grave import that it can be approached constructively only by calm consideration of the facts. A hysterical attitude, such as has been assumed by panic-stricken taxpayer groups intent iupon economy at any cost, is dangerous; indeed it contains the threat of great economic waste in the field of municipal activity.

In the conclusions Mr. Chatters draws from his analysis of the facts, he is definitely reassuring. Essentially, municipal finance is on a sound foundation, he finds. Faults exist, but they are found in details of practice rather than in fundamentals of policy or procedure.

The prime factor, of course, in determining the soundness of municipal securities is the probability of repayment at maturity. What has been the record in this regard so far? Defaults on municipal bonds during the past two years have been few. The amount of money involved is inconsiderable in proportion to the total debt outstanding. Further, most of the defaults that have really been due to basic unsoundness are found in special-assessment districts and are the result of over-ambitious real estate development, a condition largely beyond the control of municipal authorities. Outstanding debt has been steadily increasing during past years, it is true, but there is nothing mysterious or reprehensible about that. In the process of retiring old debts and contracting new ones, surely it is a commonplace that even with no increase in rate of building the outstanding total will increase as long as the new debts are made at price levels higher than those of the old debts.

Even when the investment is basically sound, however, bond defaults may occur if a city must depend upon a capricious money market for funds to meet day-to-day expenses. Some of the more spectacular defaults on serial bonds have occurred when the market for short-term loans dried up at a time when tax collections also failed. Short-term borrowing is both an expense and a financial danger. Its elimination by a proper adjustment of the tax-payment dates to the budget period would not only effect a substantial measure of economy but would also avoid much of what has been termed "banker control." Here is definite opportunity for reform.

Reform also is needed in the fields of tax collecting, budgeting and accounting. After all, the integrity of any business, public or private, depends upon its success in collecting its bills. Without proper assessment and adequate collection procedure no city can maintain a sound condition or even the respect of its citizens. Some of the practices now employed actually put a premium upon delinquency or non-payment. Budgeting and accounting are notoriously deficient. In far too many cases current and capital expenditures become hopelessly entangled and accurate cost figures for municipal service are almost impossible to determine.

In summary, an examination of the financial condition of American cities shows that it is essentially sound. Weaknesses are evident, however, in several financial departments. Informed and constructive effort is needed to bring about the required remedies.

Less Federal Work

NOTHING is clearer in the President's budget message to Congress than that after July of next year there will be a great reduction of federal construction work. The normal federal-aid highway appropriation is recommended to be cut from $125,000,000 to $40,000,000; little new work will be inaugurated under the federal public-building program, and the Treasury's building program is therefore cut $148,000,000; and river and harbor work is cut from $60,000,000 to $40,000,000. Only for flood-control work is any increase recommended. These figures do not take into account reductions in work now financed under the Emergency Relief and Construction Act. More than $90,000,000 of the $120,000,000 provided for highway work in that act had been allotted to the states at the end of November, and the remainder must be allotted before the end of June if it is to be used. The amount of $100,000,000 that had been added to the public-building fund by the Relief Act may help to speed up work early in the year, but it will only make the mid-year drop-off more apparent if private construction does not soon begin to take up the slack in large building construction.

Thus it is apparent that normal federal construction may be expected to decline after July. That will be a desirable situation if private and municipal work is then on the uptrend, for such a balancing is the aim of all stabilization efforts in the construction field. Private work, however, shows little sign of such revival. Dependence then for carry-over work rests largely on municipal construction financed by R.F.C. loans, for the R.F.C. has approved over $140,000,000 of loans for self-liquidating projects. Work on a few is actually under way, money for others is being taken up, and with the convening of many legislatures in January more funds may be released through the passage of needed legislation. Further, there are many indications that Congress will liberalize the Relief Act to foster further loans for needed community facilities. If that happens, the coming drop in federal work may be offset, in part at least.

NEWS OF THE WEEK

Chicago Gets Loan of $2,327,000 for Pumping Plant

THE Reconstruction Finance Corporation on Dec. 19, approved a loan of $2,327,000 to the City of Chicago for the replacement of three antiquated pumping stations. The R.F.C. will take 5 per cent water certificates of the City of Chicago which are secured by the revenues of the system. A net saving of $125,000 a year and a strengthening of the system are expected to be obtained by the replacement of the pumping stations and some alteration of the water mains system.

It took just seven days to put through this application. The application itself had been carefully prepared. This made it possible for the preliminary examination to proceed rapidly. Nothing new or unusual was involved and it was not necessary to question any statements made in the application. As a result, a record was established for the handling of a self-liquidating project.

The new station will be built on the site of the present Harrison St. station. It will be an all-electric installation.

Loans for three markets

A loan of $450,000 to the Friedman Bros. Holding Co. of St. Paul, Minn., for the construction of a public market was approved by the corporation on Dec. 17. The building will have 53,400 sq.ft. for stalls and other market space, 9,000 sq.ft. of basement storage (dry or refrigerator), 42,700 sq.ft. of garage space with accommodation for about 230 cars and 12,000 sq.ft. of office space. Revenues from the market, offices, garage and storage space and from filling station concessions are expected to produce $165,000 annually.

The R.F.C., on Dec. 19, agreed to loan $187,500 to the Dallas Farmers Public Market Co. of Dallas, Texas, at 6 per cent interest. The money will be used to construct a public market building in which will be sold farm products, meats, groceries and like commodities.

The market will contain 204 stalls for farmers and hucksters outside of the main building, although under roof, ten warehouses, each 25 by 50 ft., and an open unroofed concourse for 75 trucks which is suitable for use as a farmers' wholesale market.

The R.F.C. also has agreed to purchase $55,500 of the bonds of the Newark Farm Produce Market, Inc., of Newark, N. J., bearing interest at the rate of 6½ per cent, at a price of 97½. The money will be used to construct a public market on the north side of Raymond Boulevard between Chapel and Lockwood St. It will provide 171 stalls or market spaces to be rented on a nightly basis to small produce dealers. At present trading is being done on city owned land which must soon be vacated.

Construction work comprises paving a space about 129 by 338 ft. on which will be erected five platforms 15 ft. wide, slightly raised from the pavement and covered by "umbrella" sheds.

Levee district work

The important question of policy involved in the financing of the purchases of rights of way in levee districts was decided Tuesday in favor of the levee districts when the Reconstruction Finance Corporation agreed to purchase at par $500,000 of the 5½ per cent bonds of the St. Francis Levee District, an agency of the state of Arkansas. This loan paves the way for numerous similar loans along the lower Mississippi River thus adding materially to the volume of levee building, a type of work requiring a large amount of labor.

Financing of Moffat Tunnel Upheld by State Supreme Court

The long controversy over the legality of the $8,750,000 of supplemental bonds issued by the Moffat Tunnel Improvement District for the completion of the tunnel after the original bond issue had been expended was ended on Dec. 19 when the supreme court of Colorado declared that the bonds were legally issued by the district. The validity of the bonds had been attacked by the Denver Land Co. on the grounds that the act creating the district had only authorized the issue of $6,720,000 for the construction of the tunnel.

Engineers Face Second Winter of Unemployment Relief Work

UNEMPLOYMENT conditions among engineers will be worse than last year, judging by present indications. Inquiries addressed to the local sections of the American Society of Civil Engineers throughout the country as well as to the joint relief agencies set up by the engineering profession in some centers last year point definitely to that conclusion. Only in one or two instances are there encouraging signs of a lessening of unemployment among the members of the profession.

No conclusions can be drawn from the results of the inquiry as to whether any one branch of the profession will be more seriously affected than another this winter than last winter. There appears to be an indication, however, that conditions among the civil engineers will be somewhat better except in those centers where large numbers have been laid off recently, as in New York where both the Board of Transportation and the Port Authority have been compelled to let engineers go. On the other hand, there are many indications that men who nominally have jobs and men who are in private practice face a winter of greatly reduced income.

Reports from local organizations

In detail, the reports indicate the following conditions in centers where some attempt has been made to meet unemployment conditions:

The Oregon Technical Council, representing six engineering organizations, is raising a fund again this year for loans to engineers in need. If pending R.F.C. applications produce actual money, conditions may be somewhat better there this winter.

The Associated Engineering Societies of St. Louis are asking for contributions to continue their loan fund. Actual unemployment among members of the national society does not appear serious but there is considerable unemployment among other engineers.

The Topeka Engineers Club is heading up the relief work in Topeka, Kan. Its committee expects an increase in unemployment of about 50 per cent.

Engineering societies in Birmingham, Ala., have a joint committee which has raised a relief fund and is cooperating with the Community Placement Bureau in getting work for the destitute men. No increase in unemployment is expected there but more help will be needed for the men out of work.

In Arkansas some of the engineers in most need of help are being taken care of under the provisions of Title I of the Relief Act by placing them on highway work. Unemployment conditions are expected to be worse there this winter.

Central Ohio Professional Engineers Committee on Unemployment, representing local engineering groups in Columbus, is carrying forward its work organized last September. No definite indications of expected conditions are reported.

Cleveland work continued

In Cleveland the Technical Men's Relief Association, a non-profit association organized by the technical societies there last year, developed a "back to the land" movement by which they were able to provide relief work for all men who would do farm work. The association is now making plans for the coming winter as it expects to have 2,000 men registered as against 1,500 last year. The civil engineering group appears least affected, apparently because of their adaptability in adjusting themselves to work outside of their normal profession.

In Maryland the relief work is headed up by the Emergency Relief Committee of Technical Societies of Maryland. No definite data as to conditions this year are available.

In the New York Metropolitan area the Professional Engineers Committee on Unemployment has begun a campaign to raise funds for the continuation of its work this year. Registrations are in excess of last year and placements are less easily made.

Contributions to the relief fund are coming in slowly.

All engineering organizations in Philadelphia are represented by the Philadelphia Technical Service Committee. The committee was organized early this year and has cooperated with the State Employment Commission of Pennsylvania in the placement of the most needy cases. It is raising a relief loan fund.

The Providence Engineering Society has an employment committee organized last year which was successful in placing a considerable number of men but the collapse of business in the machine-tool industry makes it appear that conditions will be much worse this year. A revival of business in the textile field so far has produced almost no jobs for engineers.

Cooperative work in Boston

In Boston the Emergency Planning and Research Committee, representing both the engineering and architectural professions, is carrying forward the work done last year, concentrating on the compilation of data of value to various public agencies. Up to Dec. 15 about 767 engineers were registered with the Engineering Division.

Subway Work in New York City Continued by Allotment of Funds

Complete cessation of work on the new Independent Subway System in New York, which was threatened last week because of lack of funds, was forestalled by the city on Dec. 15 through the provision of $5,138,000 for work necessary to put the Bronx extension and the Brooklyn line as far as Borough Hall into operation. The Board of Transportation had expected to have these extensions ready for operation in December but key contracts have been held up by the city's financial difficulties and work on other contracts has been stopped because of non-payment of vouchers.

Action on the Board of Transportation's application for $450,000 for the department salary and expense accounts was put off until Dec. 20. The chairman of the board, in his report to the Board of Estimates, stated that the board had laid off 350 men, will lay off 150 more at the end of the month, and that unless money was provided for the remaining 1,500, they would have to be laid off and the contract work would have to be permitted to go on without supervision.

On Dec. 20 the Board of Estimate voted the $450,000 for salaries but took no action on financing further construction.

On Sept. 10 the Board of Transportation put into service the main trunk of the system extending from Chambers St. to 211th St. in Manhattan Island, a distance of 12.3 miles. The feeder lines which it will be possible to open with the money provided on Dec. 15 are the line through the borough of the Bronx and the one from Chambers St. under the East River to Borough Hall in Brooklyn.

Other work scheduled for early completion by the Board of Transportation will require an additional amount of a little over $3,000,000. This would add the Queens line as far as Roosevelt Ave., the Hudson-Essex St. line from Manhattan into Brooklyn and part of the Brooklyn crosstown line.

Whitehurst to Be President of Road Builders Association

H. C. Whitehurst, engineer of highways of the District of Columbia, has been nominated for election to the presidency of the American Road Builders Association at the Detroit meeting. He will succeed T. H. Cutler, chief engineer of the Missouri State Highway Department. Regional vice-presidents nominated are as follows: E. L. Benedict, vice-president, Pittsburgh Steel Co., Pittsburgh, Pa., representing the Northeastern district; Charles M. Upham, engineer-director, American Road Builders Association, representing the Southern district; Grover C. Dillman, state highway commissioner of Michigan, representing the Central district, and Stanley Abel, supervisor of the Fourth District in Kern County, Calif., representing the Western District.

Vehicle Limitations Approved by Automobile Organization

Limitations on the gross weight, dimensions and speed of motor vehicles operating on the highways of the country recommended to the state highway departments of the country by the American Association of State Highway Officials at its meeting held in Washington recently (*E.N.R.*, Dec. 1, p. 660) have been approved by the National Automobile Chamber of Commerce. The Automobile Chamber of Commerce recommends them to state legislatures for enactment into their state laws in order to obtain uniformity in such regulations.

Philadelphia-Camden Bridge Not Designed for Railroad Use

The Philadelphia-Camden bridge is not designed to carry standard railroad equipment according to a statement made to the Delaware River Joint Committee by Ralph Modjeski, the engineer who designed the bridge. Mr. Modjeski said that the bridge was designed only to carry cars such as are used in city rapid transit service.

Recently it was proposed that the Pennsylvania and the Reading railroads use the bridge to gain direct access to the city of Philadelphia.

Adverse Report on River Work Protested by Youngstown

The Chamber of Commerce of Youngstown, Ohio, has filed a formal protest with the United States Board of Engineers for Rivers and Harbors against the adverse report on the improvement of the Beaver, Shenango and Mahoning rivers in Pennsylvania and Ohio submitted to the board by the division engineer of the Upper Mississippi Valley Division. Examination of the rivers with a view to determining whether more complete development of them as waterways is economically justifiable was authorized by Congress in July 1930. In August of this year the division engineer reported against further development.

The Chamber of Commerce of Youngstown, with its brief in protest against the report submits a modified plan prepared by the Randolph-Perkins Co., engineers, Chicago.

Chicago Aerial Survey

CHICAGO COMPLETES DIAGONAL THOROFARE

The last link connecting the west side of Chicago with Lincoln Park on the Lake Front by a diagonal boulevard 78 ft. wide was completed Dec. 9 when the Ogden Ave. viaduct over Goose Island was opened to traffic. Two lift bridges are included in the structure. This $4,600,000 improvement, 3,400 ft. long, eliminates crossing at grade of two street car tracks, thirteen railroad tracks and nine streets. (See *ENR* Dec. 17, 1931, p. 952 for a full description.) The work was carried out under the direction of William Mulcahy, engineer of the Board of Local Improvements by the Great Lakes Dredge and Dock Company, general contractor.

Special Master to Report on Chicago Water Diversion

As a further step in determining whether the city of Chicago is complying with its order requiring diversion from Lake Michigan to be reduced to 1,500 sec.-ft. by Dec. 31, 1938, the U. S. Supreme Court has appointed Edward F. McLennon a special master to inquire into reported delays on the part of the Chicago Sanitary District in the work of building its sewage disposal system and to report back to the court by April 1.

Recently the court called upon the Sanitary District of Chicago to show cause why its order was not being complied with. The Sanitary Districts reply was abstracted in our issue of Nov. 17, page 602. Lack of funds as a consequence of the tax collection muddle in Cook County was given as the principal cause for the slowing up of the district's program of construction.

The points to be covered by the special master are: (1) As to the causes of the delay in obtaining approval of the construction of controlling works in the Chicago River and the steps which should now be taken to secure approval and prompt construction; (2) as to the causes of the delay in providing for the construction of the Southwest Side Treatment Works, and the steps which should now be taken for such construction or, in case of a change in site, for the construction of an adequate substitute; (3) as to the financial measures on the part of the Sanitary District or the State of Illinois which are reasonable and necessary in order to carry out the decree of this court.

Street Cars Stay on Boulevard Along Chicago Lake Shore

By a ruling of the Illinois Commerce Commission issued Dec. 2, street car tracks laid on Lake Shore Boulevard, Chicago, from Chicago Ave. south six blocks to the municipal pier as a temporary measure in 1921 and 1922 to serve an exposition on the pier may remain there. The "convenience and necessity" of the car riders using the pier are considered sufficient to warrant leaving the car tracks on this boulevard which is at the foot of the north approach to the new Outer Drive Bridge over the Chicago River. The commission ordered the tracks removed to the lake side of the boulevard which will in effect clear the boulevard of tracks except for the crossing at Chicago Ave. The car company claims that this is a "gratuitous" order since the commission can rule only on the question of convenience and necessity.

Lake Shore Drive at this point is on land conveyed to Lincoln Park by riparian owners on the condition that it be used for boulevard or driveway purposes only. This point and others not pertinent before the commission may yet give Lincoln Park grounds for ouster of the tracks when the case goes to the courts on appeal where all considerations will receive attention.

Engineering talent of note was represented on both sides. J. Rowland Bibbins and Hugh E. Young represented Lincoln Park, R. F. Kelker, the City of Chicago, and E. J. McIlraith, the street car company.

Construction of Union Station in Los Angeles Ordered

First steps in the construction of a union terminal at Los Angeles, Calif., by three transcontinental railroads must begin within twenty days from Dec. 13, according to an order issued by the California Railroad Commission on that date. The commission decided against the proposal of the Southern Pacific, Union Pacific and Santa Fe Railroads for a moratorium for the project and against reopening the case as also was proposed by the lines. The railways had pleaded for rehearing and possible abandonment of the plan for the $10,000,000 station on the grounds that economic conditions did not warrant the expenditure. In its decision, the commission said the carriers are morally and legally obligated to provide the needed facility as expeditiously as possible.

Washington Notes

By Paul Wooton
Washington Correspondent

OST of the amendments to the Reconstruction Finance Corporation Act that have been introduced at the time of this writing deal with the liberalization of that law with respect to loans for crop production or for the payment of taxes on farm property. A far-reaching amendment is proposed, however, by Rep. Sabath, of Illinois, which would empower the corporation to make loans to states, municipalities and public agencies, or to enter into contract for the purchase of their securities when more than ten years may be required for liquidation. The proposed amendment also would lift the restriction as to taxes and self-liquidation on projects "necessary to public health or welfare." This latter provision is intended to include a loan such as that needed for the completion of the Sanitary District project at Chicago.

An amendment proposed by Senator King, of Utah, will allow the corporation to make loans to aid in refunding or refinancing the obligations of irrigation and drainage districts that were outstanding at the time the original act was passed.

Amendment to the Reconstruction Finance Corporation Act, suggested in the Senate Dec. 10 by Senator Wagner, of New York, would liberalize the law so as to permit states, municipalities and public agencies to borrow on adequate security for the construction of any project which they consider necessary and sound. This would make it possible to use the corporation's fund for such work as the elimination of highway grade crossings and other undertakings which do not bring a direct return. Senator Wagner also proposes that the act be amended so that no state or municipality would have to pay interest more than one-half of one per cent higher than that paid by the federal government for long-term money.

* * *

Careful consideration is being given by the Reconstruction Finance Corporation to applications covering the development of forestry projects. The object of the study is to determine whether or not equities in land holdings might not be accepted as security for a loan to be used for lumbering operations. Such loans would be repaid from the sale of the timber.

Use of Relief Funds on Roads Adopted by Michigan Counties

A program of work relief designed to solve the unemployment problem was adopted by 33 counties of the Lower Peninsula of Michigan as a result of a conference, Dec. 12, of mayors, councilmen, supervisors and county road commissioners, called by the Michigan Committee for Trade Recovery headed by George B. Walbridge of Detroit.

Grover C. Dillman, state highway commissioner, was called upon to apply for a loan of $2,000,000 from the Reconstruction Finance Corporation, to be used exclusively for payments for labor. Negotiations for such a loan now are well under way.

Tools and equipment will be supplied by the counties in which the work is done, and the cost of material required including gravel is estimated at less than four per cent of the total cost.

The work has been laid out by the State Highway Department and lists of unemployed men have been supplied by the counties included so that work will be under way immediately after January 1. The project is planned to put 300 to 900 unemployed artisans, laborers and farmers in each county to work clearing rights-of-way, providing drainage, widening grades and trimming and planting tress. These State highway improvements will provide employment for the men from January 1 to October 1, 1933.

A similar plan has been adopted by the counties in the Upper Peninsula of Michigan and the obligation to finance the machinery and tools has been accepted by the counties.

At the conference on December 12, the requirements of the Reconstruction Finance Corporation relative to loans to municipalities for financing self-liquidating public works were explained to the public officials by the Michigan Committee for Trade Recovery. Numerous projects are now under consideration as a result, including docks, warehouses, sewage disposal works, water works and water softening systems.

Federal Aid for Coast Work Urged by Protective Association

Federal participation to the extent of 50 per cent of the cost of coast protective measures was urged as necessary to the proper continuation of such work at the annual meeting of the American Shore and Beach Preservation Association held in Washington Jan. 14. A bill now before the committee on rivers and harbors of the House of Representatives makes provision for thus dividing the cost of the work.

The work of a board consisting of three civil engineers and three civilians, recently established by act of Congress, was outlined to the association by Major-General Lytle Brown, Chief of Engineers, U. S. Army.

The destructive effect of recent storms along the New Jersey coast were described by Victor Gelineau, director and chief engineer, New Jersey State Board of Commerce and Navigation. Mr. Gelineau expressed the view that attacks by the ocean can only be successfully met by jetties of heavy rock construction. Experience has taught that permeable jetties are of relatively short life.

Dean of Engineering at Yale

Robert E. Doherty, formerly consulting engineer to the General Electric Co. at Schenectady and at the present time professor of electrical engineering at Yale, has been appointed dean of the new Engineering College of Yale University. Professor Doherty is a graduate of the University of Illinois and took post graduate work at Union College.

Architects Honor Civil Engineers

In recognition of the close fraternity between the professions of architecture and civil engineering the Architectural League gave a dinner at its clubhouse in New York on Dec. 15, at which three leading bridge engineers were guests of honor: Gustav Lindenthal, Ralph Modjeski and O. H. Ammann. C. J. Levi, president of the League, presided and A. T. North was toastmaster. The principal addresses were made by Cass Gilbert for the architects and Francis Lee Stuart, past president of the American Society of Civil Engineers, for the engineers. The guests of honor responded with accounts of some of their difficulties in developing large bridge projects. Brief remarks were made by Stephen F. Voorhees, architect, F. E. Schmitt, editor of *Engineering News-Record*, and Daniel E. Moran, foundation engineer.

After Mr. North had pointed out that the three guests have made notable use of the cooperation of able architects in their works—Henry Hornbostel for the Hell Gate Bridge, Paul Cret for the Camden Bridge, Cass Gilbert for the George Washington Bridge over the Hudson River—Mr. Gilbert outlined the evolution of the art of construction and asked whether we are willing to accept a utilitarian existence without the embodiment of a higher ideal, such as finds expression in beauty, letters and philosophy. The cooperation of engineer and architect is indispensable to giving construction its proper relation to man's existence. Their basic function is the same, namely to plan, whether a structure or a city. If they cooperate, Mr. Gilbert said, they can answer Macaulay's challenge on the enduring nature of the works of modern civilization.

Mr. Stuart glorified the long-span bridge, the civil engineer's prime achievement. Only by aid of the power of research, however, did the great spans of recent years become possible, he said. Mr. Lindenthal showed that the community of engineer and architect has existed in Europe for a century, and he traced its influence particularly through the world's expositions at Vienna, Philadelphia and Chicago. In his specific reference to large bridges he asserted that they can be made to last a few centuries and perhaps even a few thousand years if they are taken care of, but we are not yet able to give them the permanence that characterizes the great construction of Egypt and Rome. Mr. Voorhees stated that the close relation between engineer and architect becomes more essential as the economic demands of modern life become greater, and he pointed out by example the efficiency which this cooperation has already attained in building construction. Both professions depend for their results on the power of imagination, and they should join in applying it.

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual meeting, Chicago, Feb. 21-24.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION, Detroit, Mich., Jan. 16-18.

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention and road show, Detroit, Mich., Jan. 16-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, N. Y., Jan. 18-21.

AMERICAN SOCIETY OF MUNICIPAL ENGINEERS, annual meeting, Detroit, Mich., Jan. 16-18.

AMERICAN TOLL BRIDGE ASSOCIATION, annual meeting, Camden, N. J., Jan. 16-17.

AMERICAN WOOD PRESERVERS ASSOCIATION, Chicago, Ill., Jan. 24-26.

ASPHALT INSTITUTE, Asphalt Industry Conference, Detroit, Mich., Jan. 18.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, Detroit, Mich., Jan. 16-18.

CONSTRUCTION LEAGUE OF THE UNITED STATES, Detroit, Mich., Policy committee assembly, Jan. 21.

HIGHWAY AND BUILDING CONGRESS participated in by twenty national engineering societies and trade associations, Detroit, Mich., Jan. 16-20.

INTERNATIONAL ASSOCIATION OF PUBLIC WORKS OFFICIALS, Detroit, Mich., Jan. 17.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Ottawa, Ont., Feb. 7-8.

NATIONAL CRUSHED STONE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

NATIONAL READY MIXED CONCRETE ASSOCIATION, annual meeting, Detroit, Mich., Jan. 17-18.

NATIONAL SAND & GRAVEL ASSOCIATION, annual meeting, Detroit, Mich., Jan. 16-18.

PORTLAND CEMENT ASSOCIATION, Detroit, Mich., Jan. 16-18.

TACOMA SECTION, American Society of Civil Engineers, has elected W. J. Ryan president for the year 1933, Glenn L. Parker vice-president and Julian A. Arntson secretary-treasurer.

CHATTANOOGA SECTION, American Society of Civil Engineers, at its annual meeting elected Clifford E. Betts president, Joseph Wright vice-president, and F. C. French secretary-treasurer. James F. Fairleigh, of Chattanooga, was elected honorary member of the Section.

NEW YORK STATE SEWAGE WORKS ASSOCIATION will hold its fifth annual meeting in New York on Jan. 17. Following the business meeting there will be an inspection trip to the demonstration sewage treatment plant of the Guggenheim Laboratories.

PACIFIC NORTHWEST SECTION, American Water Works Association, will hold its sixth annual meeting at Bellingham, Wash., May 11-13.

Large River Contracts Awarded

Awards of nine contracts for river and harbor work were approved by the Chief of Engineers on Dec. 14 and 17. The largest contract went to the Dravo Contracting Co. of Pittsburgh, $1,572,000 for the construction of the Lock B and the dam at London on the Kanawha River in the Huntington, West Va., district. Other large contracts were $836,000 to the Ouilmette Construction & Engineering Co., Chicago, for the lock at dam No. 4 on the Mississippi River at Alma, Wis.; $263,000 to the Great Lakes Dredge & Dock Co., Cleveland, for dredging in the Livingston channel in the Detroit River; $327,000 to the Standard Dredging Co. of New York, for dredging the south end of the intracoastal waterway from the Cape Fear River in North Carolina to Winyah Bay, S. C.; and $238,000 to the Atlantic, Gulf & Pacific Co. of New York, for dredging of a channel from the inside of Brazos Santiago Pass to and including a turning basin at Port Isabel in Galveston district.

Personal Notes

R. G. BURKHART has been named field engineer for the East Side Levee and Sanitary District of East St. Louis, Ill.

EDWARD K. BRYANT and ALBERT C. JONES have taken over the private consulting practice of H. BREVOORT SMITH and FREDERICK L. BRANIN, county engineer and assistant county engineer of Burlington County, N. J., and will continue a general engineering practice in that region under the name of Bryant & Jones. Mr. Bryant formerly was with John L. Weber, Inc., of Trenton, and Mr. Jones was formerly with the state highway department. The firm's headquarters will be at Mt. Holly, N. J.

G. GALE DIXON, for the past six years deputy chief engineer of the Mahoning Valley Sanitary District, Youngstown, Ohio, has resumed his practice as a consulting engineer specializing in hydraulic and sanitary engineering work with headquarters in Youngstown. From 1922 to 1926 Mr. Dixon was associated with Frank A. Barbour in consulting engineering work in Boston. Previous to that he was on water supply work for the city of Akron, Ohio, on the Catskill aqueduct and the New York State barge canal.

Obituary

ANGUS MACLACHAN, engineer of the Edgar Clay Co., Metuchen, N. J., died Dec. 15. Mr. MacLachan formerly was an engineer of the Fuller Construction Co. of New York.

J. M. PARRISH, superintendent of construction for James Stewart & Co., contractors, died in Washington, D. C., on Dec. 17, age 57 years. Mr. Parrish has been with James Stewart & Co. for several years and has had charge of construction for them on such projects as the Cities Service building in New York, the Mitsui Bank building in Tokio. In Washington he was in charge of the company's work on new federal buildings.

OSCAR P. CHAMBERLAIN, civil engineer, a colonel in the World War, and until he retired last August, president of Dolese & Shepard Company, was killed Dec. 10 by an automobile in Chicago, as he was walking across Michigan Ave in downtown Chicago. Colonel Chamberlain was 62 years old, born in Pittstown, N. Y., and a graduate of the University of Pennsylvania. He started his career as a rodman on the Pennsylvania R.R. in 1889, served as division engineer on the Chicago Great Western R.R., as assistant engineer for the Northern Pacific R.R. and as chief engineer and president of the Chicago & Illinois Western R.R., which position in 1917 he left to go to war as a major. Colonel Chamberlain was a past president of the Western Society of Engineers.

Naming of Commissioners Urged in Interstate Water Suit

The United States Supreme Court has been asked by the states of Wyoming and Colorado to appoint commissioners, one to represent each state, to determine the relative rights of the two states in the diversion of water from the Laramie River for irrigation. Suit to determine the rights of the two states was begun some time ago by the State of Wyoming. The states recommend the naming of E. O. Whittington of Cheyenne, Wyo., and J. Howard Carpenter of Denver.

Federal Flood Control Proposed Along Lower Rio Grande Valley

Plans for a comprehensive flood control construction program along the lower sections of the Rio Grande, to cost $4,700,000 have been laid before State Department officials by R. B. Creager, of Brownsville, Texas, and W. E. Anderson and Frank Robertson, San Benito, engineers for the International Boundary Commission.

The plans have been approved by the international commission, Mr. Anderson stated, and when carried out should fully protect the lower valley from floods similar to that which caused so much destruction this summer.

While the group did not ask that the entire sum needed for the protection works be recommended at this time, they advised the department that if $1,700,000 could be secured, substantial emergency protection could be afforded the valley.

The plan generally contemplates an extensive levee line along the American bank of the river, together with four controlled floodways from the lower river into the Gulf of Mexico. The work can be done without further negotiations with Mexico, since the two countries have reached a full accord upon division of the flood waters, Anderson reported.

The two engineers likewise reported to Secretary Stimson that material progress has been made during the past year in the continued negotiations between the two countries over division of the Rio Grande water for irrigation and power purposes. They indicated that within the near future, an agreement might be reached.

In the meantime, Anderson said, the engineering division of the commission has been making fine progress upon the technical features of the combined power and irrigation project for the river, and should a treaty be secured, would be ready almost at once to make its recommendation.

The project, to cost approximately $20,000,000, and to include a series of dams from the Presidu to the mouth of the river, would make possible the generation of about 250,000 hp. of electricity and increase the irrigated acreage upon the Texas side of the river by approximately 1,000,000 acres, Mr. Anderson explained. At the present time only 500,000 acres of land on the American side are irrigated by water from the river.

Contracts and Capital

CONSTRUCTION

(Thousands of Dollars)

	Weekly Average Dec., 1931	Four Weeks	Week Dec. 22 1932
Federal government	$3,325	$6,460	$3,084
State and municipal	11,974	11,388	16,597
Total public	$15,299	$17,848	$19,681
Total private	9,727	4,522	2,780
Week's total	$25,026	$22,370	$22,461
Cumulative, Jan. 1 to date:			
1931 construction			$2,407,302
1932			1,205,428

Decrease, 48 per cent.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Weekly Average Dec., 1931	Four Weeks	Week Dec. 17, 1932
R.F.C. loans	.....	$1,600	$3,300
New capital issues	$6,000	11,300	21,100
Total	$6,000	$12,900	$24,400
Cumulative, Jan. 1 to date:			
1931 new capital			$2,010,000
1932 R.F.C. loans approved		$142,700	
1932 new capital		785,500	
1932 total			$928,200

Decrease, 54 per cent.

ENR Cost and Volume Index

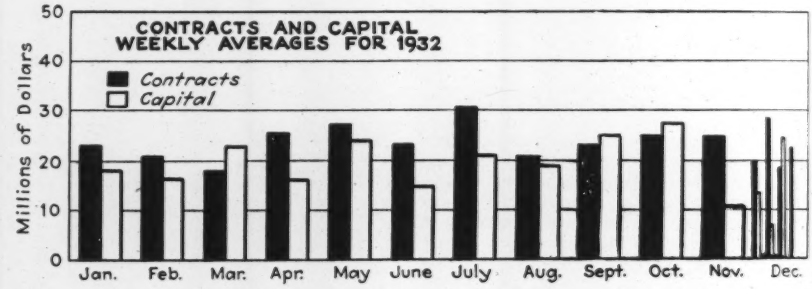
Cost		Volume	
December, 1932	**158.46**	**November, 1932**	**157**
November, 1932	158.20	October, 1932	137
December, 1931	166.23	November, 1931	180
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.85	1930 (Average)	260
1913 Average	100.00		

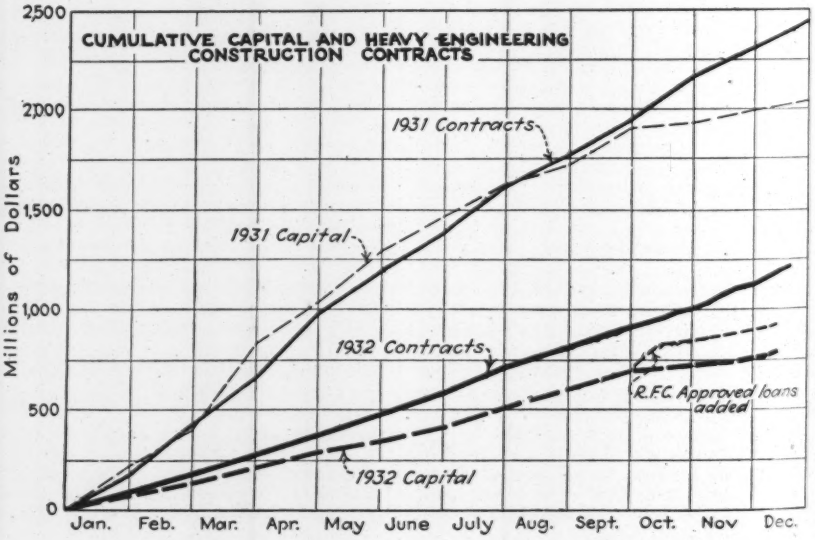
Engineering Contracts and Capital

HEAVY ENGINEERING construction contracts reported for the past week total $22,461,000, an increase of $3,500,000 over the previous week and a figure slightly ahead of the running average of the past four weeks, $22,370,000. Both federal and private contracts remained low, amounting to $3,084,000 and $2,780,000, respectively. State and municipal awards were the highest in seven weeks, totaling $16,597,000. Award for the San Jacinto 13-mile tunnel on the Colorado River aqueduct led all contracts for size. Other large contracts included cement for Missouri highways, $972,000; levees in Louisiana, $882,000; and highway awards in Nebraska, $548,000; Indiana, $711,000; Missouri, $789,000 and Mississippi, $657,000. Highway lettings for the week amounted to $6,731,000, a little under the weekly average for the past two months.

Heading the proposed list of work announced during the week is a $7,000,000 bridge at Astoria, Ore. Bids will be received in April for apartments in Newark, N. J., estimated at $2,437,000 and for the superstructure of the federal building in St. Louis, estimated at $3,000,000.

New productive capital issues for the week ended Dec. 17 total $24,400,000, mostly all public issues. These figures include six self-liquidating loans approved by the Reconstruction Finance Corp., but do not include the R.F.C. loan for the Chicago pumping station, announced Dec. 19.

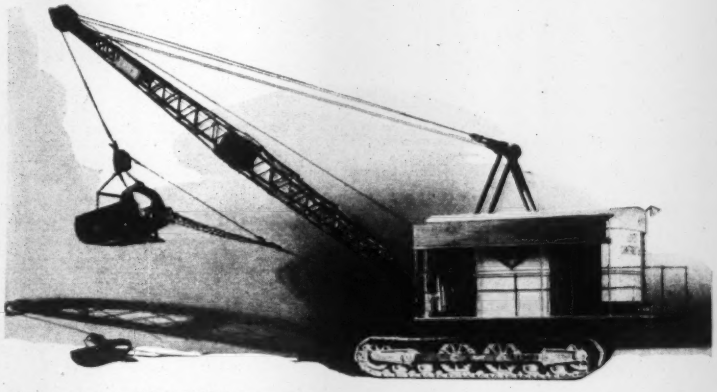




Construction Equipment and Materials

Heavy-Duty Dragline

For the levee and drainage contractor, the Ohio Power Shovel Company, Lima, Ohio, now offers the LIMA type 601 heavy-duty dragline built to meet the demand for fast drainage and levee operations. With the exception of the bevel gears, helical gears are used throughout to minimize the friction losses. Another important feature is the extra large diameter of the drums. The drums are 32 in. in diameter for a 1-in. cable. Independent clutches make it possible to hoist, travel, swing, steer, and raise or lower the boom all at the same time. The dragline is furnished in 1½ yd. and 2 yd. capacities, depending on the length of the boom used. Boom lengths range from 40 ft. to 70 ft.

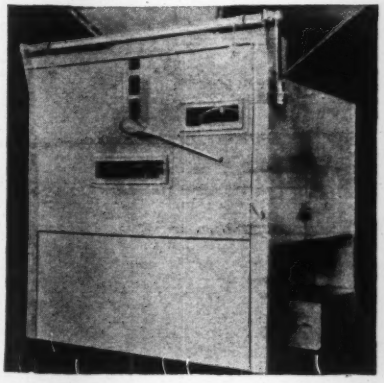


Friction losses are minimized in operation of new Lima dragline.

Automatic Weighing Batcher

The Butler Electro-Interlocked Cement Weighing Batcher, manufactured by the Butler Bin Company, Waukesha, Wis., is designed to eliminate the human element from the control of the amount of cement weighed off in each batch. The batcher is filled with a hand-operated rotary-type gate fastened to the bottom of the bin by which the flow of cement into the batcher is controlled. When the batch is about 100 lb. from the desired weight, the pointer on the dial starts to move, and the gate is partially closed, allowing the cement to flow in slowly until the dial pointer is within the allowable tolerance of 1 per cent or under when the gate is closed completely. This brings the scale into balance and makes the electric contact with the scale beam so that the batch may be discharged from the weighing hopper by pressing the button. If the batch in the hopper is more than 1 per cent under or overweight, these electric contacts will not permit the operation of the motor on the discharge gate. When the weight has been adjusted and the cement gate closed, the batch of cement is then discharged by pressing the push button located at the front of the scale housing.

Cement batcher has electrical interlocks to assure proper amount of material.



Business Notes

THE LUDLOW VALVE MANUFACTURING CO. announces the resignation of William H. Lolley as president of the company. Livingston W. Houston has been elected to succeed Mr. Lolley.

NYE STEAM PUMP & MACHINERY CO. has recently been moved to 621 South Kolmar Ave., Chicago, Ill. The business has been taken over by the same interests that control the Hannifin Manufacturing Co. and the Sherman-Manson Manufacturing Co. All three companies are now located at the same address.

MORGAN P. ELLIS announces his resignation as general sales manager of Steel & Tubes, Inc.

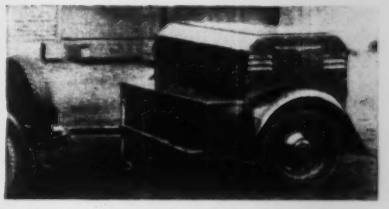
BEEBE BROS., of Seattle, Wash., manufacturers of B. B. Bros. all steel hand hoists have licensed its manufacture in Canada under Canadian patents to the London Concrete Machinery Co., Ltd., of London, Ontario.

BLAW-KNOX COMPANY, Pittsburgh, Pa., announces an arrangement with the Madsen Iron Works, of Los Angeles, Calif., whereby the Company will manufacture and sell complete plants of Madsen design and patents for pre-mixing asphaltic pavement material in territories in the United States East of the Rocky Mountains, and in countries outside of the United States.

STEPHENS-ADAMSON MFG. CO., Aurora, Ill., have acquired the United States right to manufacture and distribute the English Redler conveyor which is claimed to convey horizontally, vertically, up inclines and even around corners. A 4-page descriptive folder has been issued to explain the principle upon which the new conveyor operates.

Arc Welder Driven by Ford Engine

Universal Power Corp., Cleveland, Ohio, announce their new Ford V-8 engine-driven, 300-ampere arc welder of high speed, portable trailer type. The shunt inductor principle is used for arc stabilization. The manufacturer states that the combination of the shunt inductor coupled with the smooth flow of power of the V-8 engine, has effected a gas-driven arc-welder performance of unusual stability and flexibility. There is a horizontal radiator directly over the engine, with a blower type fan which materially effects the cooling of the entire unit. A sliding cover over the radiator allows for the proper amount of radiation and cooling, regardless of temperature conditions.



Portable arc welder by Universal Power Corp.

New Equipment in Brief

Automatic Welder. The Champion Rivet Co., Cleveland, Ohio, has entered the welding rod industry. They announce an automatic welding device of simple structure consisting of arms extended from a bus bar so arranged that as electric current passes through these arms the electrode which has been attached to the work gradually consumes itself without any effort on the part of the operator. The machine is said to be especially adapted to the welding of storage tanks and pressure vessels where longitudinal seams are prominent.

Backfill Tamper. A newly developed electric backfill tamper is announced by the Electric Tamper & Equipment Co., Ludington, Michigan. The tamper is adapted to compacting fill in trenches and also behind retaining walls and abutments, handling dry and saturated material with equal facility. The manufacturer states that when fitted with the proper tool, the machine can be used for excavating clay or shale, demolishing brick pavement and vibrating concrete on bridge decks or on similar concrete construction work. The motor is wound for 110 volts, three phase, 60-cycle current.

Smoke Density Meter. The Brown Instrument Co., Philadelphia, Pa., has developed a smoke density meter that is claimed to be easy to install and operate and which requires a minimum of attention. It is a device for measuring density of smoke in flue gases by electro-optical means. A portion of the flue gas is made to pass between a source of light and a light-sensitive device. When the smoke in the flue gas varies in density, the amount of light falling upon the photo-cell varies and the resulting current variation is transmitted to the indicating or recording meter. The meter is calibrated in terms of smoke density.

Current Construction Unit Prices

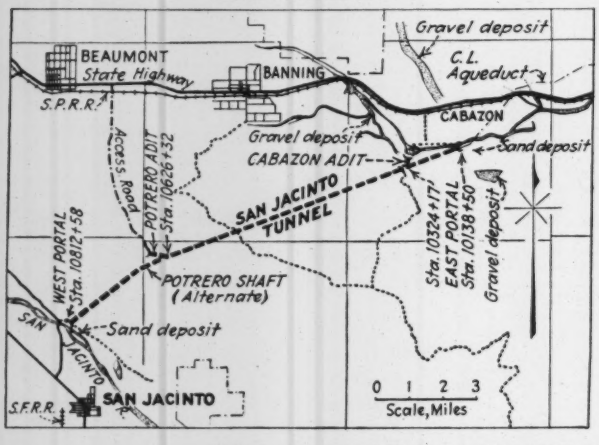
San Jacinto Tunnel, Metropolitan Water District, California

THE METROPOLITAN Water District of Southern California on Dec. 13 awarded the contract for the San Jacinto tunnel, 12.7 miles long, to the Metropolitan Engineering Corp., Los Angeles, for $7,331,815. Bidding was close between the two low bidders, the next proposal being $7,340,100, or but $8,285 higher. The work was advertised under three schedules: (1) entire tunnel; (2) east portion; (3) west portion. Contract was awarded under Schedule 1. Eight bids were received under this schedule, ranging from contract price to $13,625,850. Under Schedule 2, four bids ranged from $3,470,590 to $4,075,650. The same four bidders submitted proposals ranging from $4,337,900 to $5,433,175 for Schedule 3.

The San Jacinto tunnel is the first contract let for the building of the Colorado River Aqueduct, which will be 240.52 miles long and will contain 84.88 miles of tunnel (*ENR*, June 16, 1932, p. 847). It is a 16-ft. horseshoe section, and will be concrete lined throughout, though it is not a pressure tunnel. Driving will be done from the two portals and from two adits. Length between adits is 40,215 ft.

The District will furnish all cement, steel liner plates and steel supports, reinforcing steel and all permanent ironwork. The contractor will furnish all wood timbering, permanent timbering being paid for. Concrete aggregates will be found in near-by deposits. The contractor will be paid for hauling aggregates in excess of two miles, taken care of by Item 16 in the proposals. The minimum wage scale set for the job is given in Table I.

Map of San Jacinto tunnel showing location of adits, nearby towns and transportation facilities.



Complete unit prices submitted under Schedule 1 are given in Table II. (A) Metropolitan Engineering Corp., Los Angeles, contract; (B) Wenzel & Henoch, Milwaukee; (C) Metropilitan Construction Co., Los Angeles; (D) Shea-MacDonald & Kahn, Los Angeles; (E) Silas Mason Co., Los Angeles; (F) West Slope Construction Co., Los Angeles; (G) Rosoff Subway Const. Co., New York; (H) Atkinson Const. Co., Los Angeles. F. E. Weymouth is general manager and chief engineer of the District.

TABLE I — SCHEDULE OF PREVAILING RATES

Classification	Per Diem Wage	Classification	Per Diem Wage
Blacksmith	$6.00	Road machine operator	$5.60
Carpenter	6.00	Hoist, crane operator	6.00
Carpenter — Form work	5.60	Laborer	3.80
Compressorman	5.00	Lather	6.00
Concrete Equipment Operator	5.20	Mason	7.20
Concrete Finisher	5.60	Mechanic	6.00
Shovel operator	9.00	Miner — Machineman	5.60
Shovel operator asst.	5.20	Miner — Chucktender	5.20
Driller — Jackhammerman	5.00	Motorman	5.20
Electrician, Lineman	7.20	Mucking machine operator	8.00
Fence Erector — Steel	5.60	Painter	6.00
		Plasterer	7.20

Half cross-sections of San Jacinto tunnel showing timbered and untimbered sections. Other forms of temporary support specified are light timbering, light steel supports, steel liner plates and gunite coating.

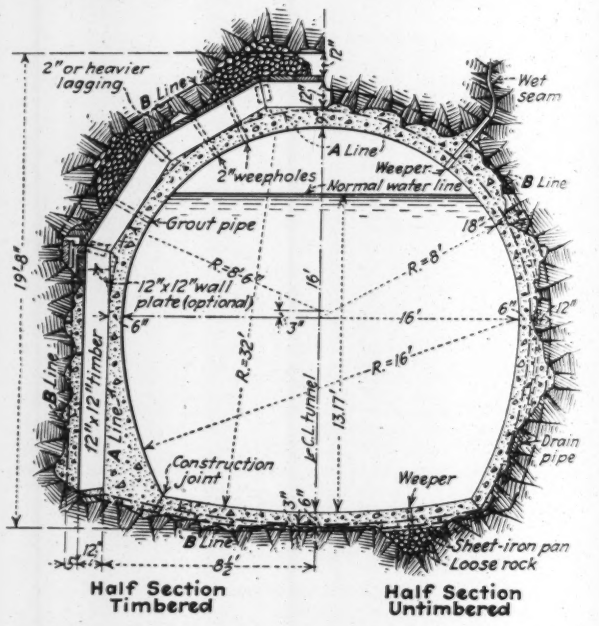


TABLE II — UNIT PRICES SUBMITTED UNDER SCHEDULE 1, SAN JACINTO TUNNEL

Item No.	Item	Quan.	Unit Prices A	B	C	D	E	F	G	H
1	Excavation — East portal adit, lin.ft.	215	$1.00	$25.00	$77.00	$48.00	$25.00	$235.00	$1.00	$300.00
2	Excavation — Cabazon adit, lin.ft.	1,500	125.00	45.00	127.00	70.00	150.00	235.00	90.00	150.00
3	Excavation — Portrero adit, lin.ft.	2,600	125.00	65.00	127.00	80.00	150.00	290.00	90.00	200.00
4	Excavation — West portal adit, lin.ft.	185	125.00	45.00	127.00	48.00	150.00	235.00	1.00	300.00
5	Excavation — Main tunnel, cu.yd.	750,000	8.10	7.90	8.00	8.80	9.10	8.85	11.00	14.00
6	Excavation — Tunnel enlargement, cu.yd.	200	15.00	12.00	12.00	14.00	15.00	50.00	5.00	14.00
7	Concrete — Cabazon adit, cu.yd.	200	20.00	14.00	20.00	18.00	6.00	35.00	10.00	15.00
8	Concrete — Portrero adit, cu.yd.	300	25.00	15.00	20.00	18.00	6.00	35.00	10.00	15.00
9	Concrete — Main tunnel, cu.yd.	195,000	3.10	5.05	8.00	7.00	6.00	7.00	7.50	10.00
10	Permanent timbering, M. f.b.m.	2,250	20.00	55.00	75.00	72.00	60.00	180.00	30.00	75.00
11	Steel supports (erection only), lb.	500,000	.01	.03	.04	.05	.02	.11	.0125	.04
12	Gunite rock coating, cu.yd.	250	25.00	27.00	20.00	16.50	25.00	28.00	19.00	25.00
13	Grout connections, each	200	15.00	6.00	8.00	3.00	15.00	9.00	3.00	3.00
14	Grout mixing and placing, cu.yd.	350	50.00	15.00	20.00	22.00	25.00	28.00	21.00	40.00
15	Reinf. steel (placing only), lb.	500,000	.02	.01	.02	.04	.01	.03	.02	.04
16	Concrete aggregate overhaul, cu.yd. miles	270,000	.05	.02	.10	.15	.05	.12	.20	.15
17	Hauling steel, ton miles	1,500	.15	.40	.15	.25	.20	1.00	.30	.30
18	Hauling sacked cement, ton miles	150,000	.01	.05	.15	.15	.05	.10	.15	.20
19	Hauling bulk cement, ton miles	150,000	.01	.05	.15	.12	.....	.10	.20	.30
	Total		7,333,315	7,347,600	8,417,725	8,611,800	8,845,925	9,788,000	10,291,300	13,670,850
	Less higher of items 18 or 19		1,500	7,500	22,500	22,500	7,500	15,000	30,000	45,000
	Total contract items		7,331,815	7,340,100	8,395,225	8,539,300	8,838,425	9,773,000	10,261,300	13,625,850